

SOIL SURVEY

Mason County Washington



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
WASHINGTON AGRICULTURAL EXPERIMENT STATIONS

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Mason County will serve various groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields, and it will add to the knowledge of other users of the report.

In making this survey, soil scientists walked over the fields and woodlands. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noticed differences in growth of crops, weeds, and brush; and, in fact, recorded all the things about the soils that they believed might affect their suitability for farming, trees, wildlife, and related uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, woods, roads, streams, and many other landmarks can be seen on the map.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose, for example, an area located on the map has the symbol Dk. The legend for the detailed map shows that this symbol identifies Dungeness silt loam, 0 to 2 percent slopes. This soil and all others mapped in the county are described in the section Descriptions of the Soils.

Finding information

Special sections of the report will interest different groups of readers. The introductory part, which mentions climate and physiography, relief, and drainage, and the section

on agriculture, will be of interest mainly to those not familiar with the county.

Farmers and those who work with farmers can learn about the soils in the section Descriptions of the Soils and then turn to the section Use, Productivity, and Capability Groups of Soils. In this way they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability subclasses; that is, groups of soils that need similar management and respond in about the same way. For instance, Dungeness silt loam, 0 to 2 percent slopes, is shown to be in capability subclass IIw. This soil and all others in capability subclass IIw have few limitations that restrict their use. Soils in the other capability subclasses have various degrees of limitation in their use.

Farmers in Mason County have organized the Mason County Soil Conservation District. The district, through its board of supervisors, arranges for farmers to receive technical help from the Soil Conservation Service in planning good use and conservation of the soils on their farms. The survey furnishes some of the facts needed for this technical help.

Soil scientists will find information about how the soils were formed and how they were classified in the section Genesis, Morphology, and Classification of Soils.

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending upon their particular interest. For example, the soil survey map and report will be useful to land appraisers, credit agencies, road engineers, and to others who are concerned with the use and management of land.

* * * *

The fieldwork for this survey was completed in 1951. Unless noted otherwise, all statements refer to conditions at the time of the survey.

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SOIL SURVEY OF MASON COUNTY, WASHINGTON

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United States Department of Agriculture, Soil Conservation Service, in Cooperation with the Washington Agricultural Experiment Stations

General Description of the County

MASON COUNTY is in the southeastern part of the Olympic Peninsula in northwestern Washington. Shelton, the county seat, and the only incorporated town in the county, is northwest of Olympia, the State capital, and southwest of Bremerton. Distances by air from Shelton to principal cities in the State are shown in figure 1.

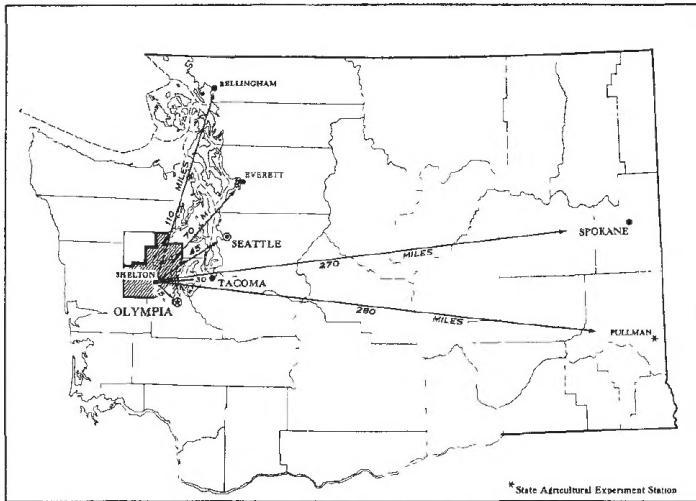


Figure 1.—Location of Mason County in Washington.

Mason County has a land area of approximately 618,880 acres, or 967 square miles. Puget Sound and the Hood Canal account for considerable areas of water in the county. This soil survey does not cover 273 square miles of Mason County that are within the boundaries of the Olympic National Park and the Olympic National Forest.

History and Population

Mason County was established in March 1854 and named Sawamish County after a tribe of Indians in

Thurston County. It included the western part of Thurston County to the Hood Canal. The county seat was first established where Shelton is now located. Shortly thereafter, it was moved to Oakland and remained there for 34 years. In 1864 the name was changed to Mason County, in honor of the first secretary of the Territory of Washington. In 1888 the county seat was reestablished in Shelton and has remained there.

The first inhabitants were Indians of the Twana and Skokomish tribes. With them, the United States Government concluded treaties that resulted in the establishment of the Skokomish Indian Reservation (4).¹

In 1903 Mason County had a population of about 4,471. By 1950 the population was 15,022, according to the United States Census. One-third is urban, mainly in and around Shelton. The rest is rural. The growth in population has been related to the expansion of the lumbering and other wood-using industries (13).

Agriculture has only a minor place in the economy of Mason County because the soils are not suitable for farming or the terrain is too rugged. Only about 7.6 percent of the county was in farms in 1954. The main farming communities are around Shelton, Matlock, Dayton, Kamilche, Grapeview, Belfair, along the Pickering Passage, and in the Skokomish River Valley. Much of the land on the average farm is covered by second-growth forest or is in stump pastures. Dairying is the most important type of agriculture; poultry raising is second. Hay is the predominant crop, but grapes (8) are produced in large quantities. Growing of berries and fruits and raising of beef cattle are of lesser importance.

Mason County is noted for its beautiful scenery and recreational facilities. On the shores of Hood Canal are many of the most beautiful vacation resorts and summer homes in Washington (fig. 2). Part of the Olympic National Park, nationally known for its wilderness and rugged beauty, is in the county and easily accessible by good roads. The county offers excellent hunting; deer, elk, and bear are plentiful. The many streams,

¹ Italic numbers in parentheses refer to Literature Cited, p. 76.

rivers, and lakes abound with game fish. Salmon fishing is excellent in Puget Sound and Hood Canal.



Figure 2.—Summer resort and recreational area along shore of the Hood Canal. The escarpment is Hoodspur soil material.

Industries

Lumbering is the leading industry in the county. It is concentrated in and near Shelton. Smaller enterprises in Shelton include plywood manufacturing, harvesting of Christmas trees and of brush and fern for the eastern flower trade; processing of dairy and poultry products; and packing and shipping of oysters. Outside of Shelton the principal industrial plants are the many, small mills producing lumber and shingles; the plants packing oysters; and the wineries. Summer resorts and recreational businesses are also important.

Mason County has a well-assured future economy. Two things contribute to this: (1) The large volume of timber still available for harvest (3), and (2) the sustained-yield operations adopted by the wood-using industries. State and Federal laws have been enacted to promote sustained-yield forest management and to stabilize forest communities, industries, and employment. In 1944 the Simpson Logging Company developed a forest management program that allows it to manage its cutover lands on a sustained-yield basis and to purchase supplemental standing timber from lands owned by the Federal and State Governments.

Transportation and Markets

Mason County is served by a branch line of the Northern Pacific Railway that runs from the Grays Harbor area to Shelton. Barges and rafts that enter Ham-

mersley Inlet transport a large volume of forest products to shipping centers in Olympia, Tacoma, and Seattle. Excellent highways connect all important areas of the county with the large nearby cities. United States Highway No. 101 traverses the county from north to south. Hard-surfaced or well-graded gravel county roads lead to all rural areas. Shelton is served by an airport having a hangar and two paved runways more than 5,000 feet long.

Agricultural development of the county is limited because of long distances to markets or to processing plants in Olympia, Tacoma, or more distant points. Farming areas nearer these markets have a considerable advantage over those more distant.

Community Facilities

Schools are maintained in all parts of Mason County. Shelton has modern grade schools, a junior high school, and a senior high school. Schoolbus service to a large area surrounding the town is furnished. The southwestern part of the county is served by a combination grade school and high school located near Matlock. Numerous other modern grade schools are located in different parts of the county. Schoolbus service is available in the remotest parts of the county. An excellent hospital and two clinics are in Shelton. In addition the town has a public library. The densely populated areas have good telephone service, and the rural districts are scheduled to have it in the near future.

The Mason County Public Utility District provides electricity to all but the most isolated areas. Electricity is obtained from power plants on the Skokomish River. This source of current is supplemented by that obtained from Bonneville Dam. A main transmission line connects Shelton and the Bonneville power plant.

The beautiful natural surroundings provide abundant recreational facilities. Fishing, hunting, boating, camping, swimming, picnicking, and touring along the scenic drives are enjoyed by all residents and visitors. Many of the small farms are located in resortlike surroundings.

Physiography, Relief, and Drainage

Most of Mason County lies in the structural downfold that is common to the Central Valley of California, the Willamette Valley of Oregon, and the Cowlitz Valley and Puget Sound Basin of Washington. The mountainous area in the west is in the Coast Range Province (19).

The dominant topographic features are (1) the high, jagged peaks and precipitous slopes of the Olympic Mountains in the northwestern part of the county; (2) the lower and more rounded Black Hills along the southern border; and (3) the lower lying, rolling glacial moraine and the nearly level outwash plain. The Olympic Mountains in Mason County have an elevation of more than 6,000 feet, and the Black Hills, around 1,500 feet. The glacial plain ranges from sea level to an elevation of 1,000 feet, but most of it has an elevation of 300 to 400 feet.

The glacial plain is cut by numerous stream channels and dissected by the inlets of Puget Sound. Chief among the inlets is the Hood Canal, which penetrates

the county from the north for a distance of nearly 20 miles, then turns abruptly to the northeast for another 17 miles. The Hood Canal almost separates a large section of about 90 square miles from the rest of the county. The Skokomish River has cut a deep gorge in the Skokomish Valley, through which it flows from Lake Cushman to the Hood Canal. The river channel, originally part of Hood Canal, and the eastern arm of the Hood Canal separate the county into northern and southern halves. The northern half is bisected by the main part of Hood Canal. Skokomish Valley, the Hood Canal, and the streams and rivers entering them are deeply incised, and the sides are steep and broken.

Three principal river systems and numerous small streams drain Mason County. The two largest rivers, the Hamma Hamma and the Skokomish, drain the northwestern part. They are swiftly flowing, deeply incised rivers that originate in the high Olympic Mountains and empty into Hood Canal. Considerable alluvium has been deposited in the Skokomish Valley.

The southwestern part of the county is drained by the many tributaries of the Satsop River, which converge at the southwestern corner of the county and flow south to the Chehalis River. The Chehalis River formerly carried water from the western lobe of the Vashon glacier. The northern tributaries of the Satsop River originate in the southern part of the Olympic Mountains and flow at reduced gradient upon the large outwash plain. The eastern tributaries of the Satsop River originate on the outwash plain or on the foot slopes of the Black Hills. Narrow bands of alluvium border most of the tributaries.

All of the eastern part of the county is drained by lesser streams, which flow only short distances before reaching outlets to Puget Sound. One of the longest of these is Tahuya River, which drains most of the nearly isolated peninsula in the northeastern part of the county. Little alluvium occurs along these streams.

Elevations in the county range from sea level to 6,445 feet on Mount Skokomish. Nearly all of the towns and villages are on shores of the inlets of Puget Sound and are only a few feet above sea level. All farmlands are less than 600 feet above sea level. Elevations of some of the places away from Puget Sound are Dayton, 246 feet; Matlock, 443 feet; Schafer State Park, 120 feet; Shelton Airport, 277 feet; and Staircase Rapids, 927 feet.

Climate

Mason County has the mild, equable climate of Puget Sound Basin. The prevailing winds, influenced by Puget Sound and the Pacific Ocean, eliminate periods of extreme heat and cold and, thus, modify summer and winter temperatures. The rainfall is fairly high, but torrential storms seldom occur. Moisture is readily absorbed by the soil without destructive runoff and erosion. The annual rainfall ranges from a low of about 50 inches to a maximum of about 100 inches, according to location in the county. More rain falls near the Olympic Mountains, and the amount increases with altitude. The average annual temperature is about 50 degrees. The average high is 60 degrees, and the low is 40 degrees. In the mountains, temperatures decrease as the altitude increases. In summer, the nights are always

cool and the days seldom hot. The winds are moderate; destructive winds occur infrequently. Tornadoes have never occurred. Except in the high mountains, snowfall is normally under 30 inches, and it stays on the ground for only a short period.

Temperature and precipitation data compiled from the United States Weather Bureau records are given in table 1.

TABLE 1.—Temperature and precipitation at Grapewview, Mason County, Wash.

[Elevation, 20 feet]

Month	Temperature ¹			Precipitation ²			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1929)	Wettest year (1933)	Average snowfall
December	40.9	61	10	9.13	8.49	25.29	0.9
January	39.0	62	8	8.44	1.79	10.16	3.7
February	41.2	70	8	6.18	2.54	4.88	1.8
Winter	40.4	70	8	23.75	12.82	41.33	6.4
March	45.6	79	20	4.99	6.31	7.92	(3)
April	50.2	87	27	2.99	4.65	7.2	(3)
May	55.6	94	30	2.25	1.77	3.04	0
Spring	50.5	94	20	10.23	12.73	11.68	(3)
June	60.7	102	36	1.41	1.88	1.21	0
July	65.0	102	40	66	17	1.05	0
August	65.2	99	41	92	44	43	0
Summer	63.6	102	36	2.99	2.49	2.69	0
September	59.9	93	34	2.05	16	5.90	0
October	52.5	82	25	4.55	1.58	5.98	(3)
November	45.3	70	23	7.92	1.26	4.84	2
Fall	52.6	93	23	14.52	3.00	16.72	2
Year	51.8	102	8	51.49	31.04	72.42	6.6

¹ Average temperature based on a 47-year record, through 1955; highest and lowest temperatures on a 44-year record, through 1952.

² Average precipitation based on a 47-year record, through 1955, wettest and driest years based on a 47-year record, in the period 1908-55; snowfall based on a 41-year record, through 1952.

³ Trace.

The winters are wet and the summers are dry. Most of the rain falls outside the growing season, or from October to March. December is the wettest month. Only about 6 percent of the rainfall occurs during the summer months. July is especially dry, with an average of less than 1 inch of rainfall. Crops on the well-drained soils are damaged in dry weather. In very dry years pastures and crops are severely damaged on all but the wettest soils. Because of these hazards, most farms are on bottom-land soils having restricted drainage. These soils must be artificially drained; otherwise, they are too wet for proper management of crops and pastures.

Local variations in elevation, air drainage, exposure, and nearness to water cause differences in the occurrence of frost. Pockets subject to frost occur in low-lying val-

leys more often than on slopes where the air drainage is good. Areas adjacent to Puget Sound have good air drainage and exposure, enjoy a longer frost-free period than those more distant, and are less affected by late frosts in spring and early frosts in fall. Most of the grapes and berries are grown in areas near the sound.

According to Weather Bureau records at Grapeview, the latest frost in spring occurred May 11; the earliest, October 4. The average length of the frost-free season is 203 days, beginning April 17 and ending November 6.

The humidity is relatively high and results in a heavy dew and fog when the temperature is lowered. This phenomenon is particularly beneficial in the prevention and control of forest fires. However, during the driest part of summer, the danger of forest fires is acute.

Water Supply

The supply of water for domestic and livestock uses is adequate in all parts of the county. Water for towns and resorts is obtained from the abundant springs and streams. Water for farms is obtained through wells from 25 to 75 feet deep. The water supply is abundant, except during long droughts. Water is obtained with more difficulty in the gravelly soils of the outwash plains. Irrigation is not commonly practiced.

Vegetation

The native vegetation consisted mainly of dense stands of coniferous trees and an understory of smaller trees, shrubs, and mosses. Conifers originally covered all the land. Most of the accessible land, about three-fourths of the county area, has been cut over. In most places the land has restocked naturally with the original species of trees and the stands are growing as dense as those on the land originally. The trees are smaller but equally dense on the steeper and higher slopes and on the droughtier soils. Forests on the high ridges and peaks of the Olympic Mountains have difficulty surviving the climate and are less dense. There are some small bogs and open, grassed prairies.

Douglas-fir (*Pseudotsuga menziesii*) (16) is the dominant forest species, and it grows extensively throughout all parts of the area covered by this soil survey. It often occurs in pure or nearly pure stands. Douglas-fir grows under many conditions but does best where the subsoil is well drained to excessively drained. It is the principal conifer to restock cutover land. Western hemlock (*Tsuga heterophylla*) is associated with Douglas-fir in most areas but is much less abundant. Although previously rejected as a lumber tree, hemlock is now an important pulpwood species. Western redcedar (*Thuja plicata*) commonly grows on sites that are moist in summer. Its habitat usually indicates that the soil has a good capacity to hold available moisture, that the site gets moisture as seepage from adjacent slopes, or that the water table is within 5 or 6 feet of the surface.

Of the less important coniferous trees, lodgepole pine (*Pinus contorta*) is the most abundant. Although limited in the original forest, very dense stands have become established on many of the drier logged-off sites. This pine retards the normal restocking of Douglas-fir and

has become a problem on the drier sites. Lodgepole pine is most likely to become established where severe burns have killed the seeds of Douglas-fir. The fire-resistant cones of the lodgepole pine survive the fire and allow this species to become established with little or no competition. Douglas-fir begins growth slowly on such sites. It remains to be seen whether the fir will eventually replace the pine and grow to merchantable timber.

Occasional scattered stands of grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*), western white pine (*Pinus monticola*), and western yew (*Taxus brevifolia*) are in the county. One or two of the drier sites have recently been planted to yellow pine (*Pinus ponderosa*), and one small area south of Matlock was planted many years ago to California redwood (*Sequoia sempervirens*). The yellow pine and redwood are not native to the county. The redwoods have grown but little in this cool climate, and only a few stunted trees remain. The following trees grow at elevations above 3,000 feet on the slopes of the Olympic Mountains: Amabilis fir (*Abies amabilis*), noble fir (*A. procera*), and yellow cypress (*Chamaecyparis nootkatensis*).

Deciduous trees grow in association with the conifers but are most abundant where summer moisture is favorable. The most common deciduous trees are red alder (*Alnus oregona*); Oregon, or bigleaf, maple (*Acer macrophyllum*); vine maple (*Acer circinatum*); dogwood (*Cornus nuttallii*); and willow (*Salix* spp.). These species rapidly invade logged areas, regardless of soil conditions. Oregon crabapple (*Malus fusca*) grows in bogs that usually dry out in summer. The Oregon ash (*Fraxinus oregona*) grows in very wet areas; quaking aspen (*Populus tremuloides*), on wet areas having a dense subsoil. Black cottonwood (*P. trichocarpa*) is common along the larger streams. Madrona (*Arbutus menziesii*) is common on well-drained soils but is seldom far from the influence of salt water. Oregon oak (*Quercus garryana*) usually grows on the prairies and is an indication of a prairie soil.

The more common shrubs are cascara sagrada (*Rhamnus purshiana*), the bark of which is valued for medicinal purposes; hazelnut (*Corylus californica*); blue elderberry (*Sambucus glauca*); bitter cherry (*Prunus emarginata*); and on the driest soils or prairies, the scotch broom (*Cytisus scoparius*).

The understory on cutover soils is a luxuriant and dense growth of different plants, many of which grow to heights ranging from 6 to 8 feet. The ground cover consists largely of salal (*Gaultheria shallon*), oregon-grape (*Berberis aquifolium*), rhododendron (*Rhododendron californicum*), snowberry (*Symporicarpus albus*), blue huckleberry (*Vaccinium ovatum*), thimbleberry (*Rubus parviflorus*), trailing blackberry (*R. macro-petalus*), evergreen blackberry (*R. laciniatus*), blackcap (*R. leucodermis*), and devil'sclub (*Oplopanax horridum*). Common on the drier soils but unusual west of the Cascade Mountains, is manzanita (*Arctostaphylos tomentosa*). Kinnikinnick (*Arctostaphylos uva-ursi*) commonly grows to a thick ground cover on the drier sites. Mixed with these plants in the ground cover are various ferns and mosses. The most widely distributed, thickest growing, and of greatest nuisance is the bracken fern (*Pteridium aquilinum* var. *lamuginosum*), which invades

cutover land and cleared areas. The swordfern is commonly found in moist or very shady sites, especially in virgin coniferous or deciduous forests. The foliage of the swordfern and the extensively growing blue huckleberry are harvested and shipped east for use as "green" in floral design. Some salal, which is called lemonleaf on the market, is also harvested and shipped east. Several bogs of Orcas peat soils contain marketable sphagnum moss, but only a small quantity is harvested.

Together with the numerous water-tolerant grasses, mosses, reeds, sedges, and other water-loving plants growing in the swamps are the hardhack or spirea (*Spiraea douglasii*), wild rose (*Rosa gymnocarpa* and *R. nutkana*), and skunkcabbage (*Lysichiton americanum*). The sphagnum peat bogs contain Laborador-tea, or ledum (*Ledum groenlandicum*); cranberry (*Vaccinium oxycoccus*); and sundew (*Drosera rotundifolia*).

Plant communities may be used as evidence of soil drainage. They rarely can be used alone as indicators of an individual soil type, but they are often helpful.

Soils of Mason County

This section discusses methods used in surveying soils, defines terms used in describing soils, and provides detailed descriptions of the soils in Mason County.

Soil Survey Methods and Definitions

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts that he observes, and maps their boundaries on an aerial photograph or other map.

FIELD STUDY.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern; they are located according to the lay of the land. Usually they are not more than a quarter of a mile apart, and in places they are much closer. In most soils each boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn things about this soil that affect its capacity to support plant growth.

Color is usually related to the amount of organic matter in soils of the same texture and clay mineralogy. The darker the surface soil, the more organic matter the soil contains. Streaks and spots of gray, yellow, and brown in the lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. It is later checked by laboratory analyses. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate.

Structure, which is the way the individual soil particles are arranged in larger grains, and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation.

Parent material is the unconsolidated mass of rock material from which the soil profile develops. It affects the quantity and kind of plant nutrients the soil may have naturally. Soils from clay, shale, and limestone are usually more fertile than those from sandy materials, and they tend to retain their natural fertility longer under cultivation.

Other characteristics observed in the course of the field study and considered in classifying the soil include the following: The depth of the soil over bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; the degree of erosion; the nature of the underlying parent material from which the soil has developed; surface and internal drainage; and acidity or alkalinity of the soil as measured by chemical tests.

CLASSIFICATION.—On the basis of the characteristics observed by the survey team or determined by laboratory tests, soils are classified by series, types, and phases.

Soil series.—Two or more soil types that differ in surface texture, but that are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Soil type.—Soils having the same texture in the surface layers and that are similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices, therefore, can be specified more easily than for soil series or yet broader groups that contain more variation.

Miscellaneous land types.—Fresh stream deposits, or rough, stony, and severely gullied land that have little true soil are not classified in types and series; they are identified by descriptive names, such as Riverwash, or Rough broken land.

Soil complex.—When two or more soils are so intricately associated in small areas that it is not feasible to show them separately on the soil map, they are mapped together and called a soil complex. An example of this is the Tebo-Astoria complex.

Undifferentiated soils.—Two or more soils that are not regularly associated geographically may be mapped as an undifferentiated group—a single unit—if the differences between them are too slight to justify a separation. An example is Illoquiam and Astoria silt loams, 5 to 15 percent slopes.

General Characteristics of the Soil Series

The soils of Mason County differ in color, texture, and degree of stoniness. Another easily noticed differ-

ence that occurs below the surface is compactness of the subsoil or underlying material. Some of the soils are excessively dry and droughty; others are waterlogged and swampy. Differences in parent material or in length

TABLE 2—Topographic position, parent

Topographic position and origin	Soil series	Parent material	Substratum	Relief
Upland:				
Residual, nonglacial	Astoria	Shale and sandstone	Compact and weathered	Hilly to rolling
	Hoquiam	Mixed old terrace	Compact clay and silt	Hilly to rolling
	Tebo	Basic igneous rock and mixed glacial material	Bedrock	Hilly to mountainous
Glacial moraine	Alderwood	Gravelly glacial till	Cemented	Rolling to steep
	Delphi	Glacial till over basalt	Cemented	Rolling to hilly
	Harstine	Sandy glacial till	Cemented	Rolling to steep
	Hoodsport	Gravelly glacial till	Cemented	Undulating to steep
	Shelton	Gravelly glacial till	Cemented	Rolling to steep
	Sinclair	Gravelly glacial till	Cemented	Undulating to hilly
Glacial outwash plains and eskers	Everett	Gravelly glacial drift	Loose gravel	Gently undulating to hilly
	Carstairs	Gravelly glacial drift	Loose gravel	Nearly level
	Grove	Gravelly glacial drift	Loose gravel	Gently undulating to hilly
	Indianola	Sandy glacial drift	Loose sand	Hummocky and rolling
	Lystair	Sandy glacial drift	Loose sand	Undulating to hilly
Glacial lake	Cloquallum	Glacial lake sediment	Firm silt	Gently rolling to rolling
	Kitsap	Glacial lake sediment	Firm silt	Undulating to rolling
	Nordby	Glacial lake sediment	Stratified sand, gravel, and silt	Undulating to rolling
	Saxon	Glacial lake sediment	Stratified sand and silt	Rolling
Terrace	Belle	Mixed sedimentary material	Silty and friable	Gently sloping
	Le Bar	Compact, mixed terrace material	Firm, gravelly sandy loam	Gently sloping
	Nasel	Gravelly glacial drift	Compact gravel	Gently sloping
	Sol Duc	Mixed glacial gravel	Loose gravel and sand	Gently sloping
	Wadell	Basaltic alluvium	Loose and gravelly	Gently sloping
Depression				
Mineral soils, upland	Bellingham	Glacial lake sediment	Silt and clay; firm	Nearly level
	Deckerville	Gravelly glacial drift	Gravel and sand; compact	Nearly level
	Edmonds	Sandy glacial drift	Sandy loam or brown sand, friable	Nearly level
	Koch	Gravelly drift	Gravel and sand, loose	Nearly level
	McKenna	Gravelly glacial drift	Gravel and sand, compact	Nearly level
	Norma	Sandy glacial drift	Sandy and compact	Nearly level
	Stimson	Mixed old terrace	Silt and clay; firm	Nearly level
Organic soils	McMurray	Woody peat	Organic	Level
	Mukilteo	Sedge peat	Organic	Level
	Orcas	Moss	Organic	Level
	Semiahmoo	Sedge peat	Organic	Level
	Tacoma	Sedge and tidal material	Organic	Level
	Tanwax	Sedimentary peat	Organic	Level
Bottom land	Belfast	Glacial alluvium	Coarse sand and gravel	Gently undulating
	Dungeness	Mixed alluvium	Silt and sand	Gently undulating

See footnotes at end of table.

of time the soils have been developing are scarcely noticeable to anyone but the trained observer.

Table 2 lists the soil series of Mason County accord-

ing to topographic position and the kind of parent material and, for each, the relief and drainage under which they have developed.

material, and major characteristics of soil series

Internal drainage ¹	Surface soil		Subsoil			Approximate depth to substratum
	Color ²	Consistence ³	Color ²	Texture	Consistence ³	
Medium	Dark brown	Friable	Brown and yellowish brown.	Silty clay loam	Firm	Inches 32-45
Medium	Reddish brown	Friable	Yellowish red	Silt loam	Firm	48-60
Medium	Reddish brown	Friable	Yellowish red to strong brown.	Clay loam	Firm	36-72
Medium	Brown	Friable	Pale brown	Gravelly sandy loam	Very friable	24-32
Medium	Brown	Friable	Yellowish brown	Gravelly loam	Friable	48-60
Medium	Brown	Friable	Pale brown	Gravelly sandy loam to gravelly loamy sand	Very friable	24-32
Medium	Reddish yellow	Friable	Brownish yellow	Gravelly sandy loam	Very friable	22-28
Medium	Brown to strong brown	Friable	Reddish yellow	Gravelly sandy loam	Very friable	30-36
Medium	Grayish brown	Friable	Very pale brown	Gravelly loam	Friable	28-42
Very rapid	Pale brown	Very friable	Light yellowish brown	Gravelly sandy loam to gravelly loamy sand.	Very friable	18-24
Very rapid	Very dark gray	Very friable	Brown to reddish brown.	Gravelly sandy loam	Very friable	20-50
Very rapid	Reddish brown	Very friable	Light brown	Very gravelly loamy sand	Very friable	24-32
Very rapid	Brown	Very friable	Pale brown	Loamy sand	Very friable	26-30
Very rapid	Brown	Very friable	Reddish yellow	Loamy sand	Very friable	25-30
Medium	Pale brown to brown	Friable	Light brown to brown	Silt loam to silty clay loam.	Firm	24-28
Medium	Light brownish gray	Friable	Light gray	Silty clay loam	Firm	36-40
Medium	Brown or dark reddish brown.	Friable	Reddish yellow	Loam	Friable and firm.	32-36
Medium	Brown	Friable	Pale brown	Silt loam	Friable and firm.	30-36
Medium	Dark grayish brown	Friable	Light yellowish brown	Silt loam or silty clay loam.	Friable	30-40
Medium	Dark brown	Friable	Yellowish brown	Silt loam	Friable	38-48
Medium	Dark reddish brown	Friable	Brown	Gravelly loam	Friable	24-45
Rapid	Brown or grayish brown	Friable	Light yellowish brown	Gravelly loam or gravelly sandy loam.	Very friable	30-35
Medium	Reddish brown	Friable	Reddish brown	Gravelly loam to gravelly clay loam.	Friable	24-28
Very slow	Very dark gray	Friable	Light gray	Clay	Firm	24-30
Rapid	Very dark gray	Friable	Dark grayish brown	Gravelly clay loam	Firm	24-34
Rapid	Grayish brown	Friable	Light gray	Sandy loam or fine sandy loam.	Friable	18-30
Rapid	Dark gray or dark grayish brown.	Friable	Grayish brown	Gravelly sandy loam	Firm	24-28
Medium	Dark gray	Friable	Light brownish gray	Gravelly loamy sand	Firm	24-30
Medium	Dark gray	Friable	Light brownish gray	Loamy sand	Friable	24-32
Very slow	Gray or dark grayish brown.	Friable	Light brownish gray	Silty clay	Firm	28-36
Medium	Dark brown	Friable	Brown	Peat	Fibrous	30+
Medium	Dark brown	Friable	Brown	Peat	Fibrous	30+
Medium	Yellowish brown	Fibrous	Yellowish brown	Peat	Fibrous	30+
Medium	Dark brown to dark grayish brown.	Friable	Brown	Peat	Fibrous	30+
Medium	Brown	Fibrous	Brown	Peat	Fibrous	16-24
Slow	Very dark grayish brown	Friable	Dark grayish brown or dark brown	Peat	Firm	30+
Rapid	Brown	Friable	Pale brown	Sandy loam	Friable	42-50
Medium	Brown	Very friable	Pale brown to grayish brown.	Fine sandy loam and silt loam.	Friable	30-46

TABLE 2. -Topographic position, parent

Topographic position and origin	Soil series	Parent material	Substratum	Relief
Depression—Continued				
Bottom land—Continued	Eld.....	Basalt, sandstone, and shale alluvium	Sand and gravel	Gently undulating
	Juno.....	Glacial alluvium.....	Gravel.....	Gently undulating.....
	Maytown.....	Basalt, sandstone, and shale alluvium.	Medium sand, fine texture	Gently undulating.....
	Nuby.....	Glacial alluvium.....	Sand, silt, and gravel.....	Gently undulating.....
	Pilchuck.....	Mixed alluvium.....	Sand and gravel	Gently undulating.....
	Puget.....	Mixed alluvium.....	Silt and clay.....	Gently undulating.....
	Skokomish.....	Mixed alluvium	Silt, clay, and sand.....	Gently undulating.....
	Wapato.....	Basalt, sandstone, and shale alluvium.	Silt, clay, and fine sand	Gently undulating.....

¹ Refers to downward movement of water in absence of a high water table. ² Color when soil is dry.

Descriptions of the Soils

In this section the soil series and mapping units are described in detail and their relation to agriculture is set forth to the extent that knowledge permits.

The approximate acreage and proportionate extent of the soils mapped in this county are listed in table 3, and the important characteristics of all soils mapped are summarized in table 4. The location and distribution of the soils are shown on the soil map in the back of the report.

TABLE 3.—Approximate acreage of soils in Mason County, Wash.

Soil	Acres	Percent	Soil	Acres	Percent
Alderwood gravelly sandy loam, 5 to 15 percent slopes.....	80,510	13.0	Edmonds fine sandy loam, 0 to 2 percent slopes.....	110	(1)
Alderwood gravelly sandy loam, 15 to 30 percent slopes.....	8,669	1.4	Edmonds silt loam, 0 to 2 percent slopes.....	96	(1)
Alderwood gravelly sandy loam, 30 to 45 percent slopes.....	4,571	.7	Eld silt loam, 0 to 3 percent slopes.....	58	(1)
Alderwood gravelly loam, 5 to 15 percent slopes.....	221	(1)	Everett gravelly sandy loam, 5 to 15 percent slopes.....	8,414	1.4
Astoria silt loam, 15 to 30 percent slopes.....	9,420	1.5	Everett gravelly sandy loam, 0 to 5 percent slopes.....	3,440	.6
Astoria silt loam, 5 to 15 percent slopes.....	1,303	.2	Everett gravelly sandy loam, 15 to 30 percent slopes.....	6,883	1.1
Belfast sandy loam, 0 to 3 percent slopes.....	366	1	Everett gravelly loamy sand, 0 to 5 percent slopes.....	526	.1
Belfast silt loam, 0 to 3 percent slopes.....	134	(1)	Everett gravelly loamy sand, 5 to 15 percent slopes.....	2,332	.4
Belle silt loam, 0 to 5 percent slopes.....	277	(1)	Everett gravelly loamy sand, 15 to 30 percent slopes.....	1,353	.2
Bellingham silt loam, 0 to 3 percent slopes.....	1,831	.3	Gravel pit.....	58	(1)
Bellingham silty clay loam, 0 to 3 percent slopes.....	455	.1	Grove gravelly sandy loam, 0 to 5 percent slopes.....	41,770	6.8
Carstairs gravelly loam, 0 to 5 percent slopes.....	5,503	1.0	Grove gravelly sandy loam, 5 to 15 percent slopes.....	10,494	1.7
Cloquallum silt loam, 5 to 15 percent slopes.....	9,368	1.5	Grove gravelly sandy loam, 15 to 30 percent slopes.....	3,529	.6
Cloquallum silt loam, 0 to 5 percent slopes.....	604	.1	Grove gravelly sandy loam, 30 to 45 percent slopes.....	1,056	.2
Cloquallum silt loam, 15 to 30 percent slopes.....	735	.1	Grove cobble sandy loam, 0 to 5 percent slopes.....	2,133	.3
Cloquallum silty clay loam, 5 to 15 percent slopes.....	532	.1	Grove cobble sandy loam, 5 to 15 percent slopes.....	622	.1
Cloquallum silt loam, moderately shallow over cemented till, 5 to 15 percent slopes.....	2,868	.5	Grove cobble sandy loam, 15 to 30 percent slopes.....	201	(1)
Coastal beach, 0 to 2 percent slopes.....	130	(1)	Grove stony sandy loam, 0 to 5 percent slopes.....	367	.1
Deckerville gravelly loam, 0 to 2 percent slopes.....	586	.1	Grove gravelly loam, 0 to 5 percent slopes.....	383	.1
Deckerville silt loam, 0 to 2 percent slopes.....	422	.1	Grove gravelly loam, 5 to 15 percent slopes.....	144	(1)
Deckerville silty clay loam, 0 to 2 percent slopes.....	318	.1	Grove gravelly loam, basin phase, 0 to 5 percent slopes.....	594	.1
Deckerville gravelly silty clay loam, 0 to 2 percent slopes.....	40	(1)			
Delphi gravelly loam, 5 to 15 percent slopes.....	1,138	.2			
Delphi gravelly loam, 15 to 30 percent slopes.....	1,328	.2			
Dungeness fine sandy loam, 0 to 2 percent slopes.....	1,858	.3			
Dungeness silt loam, 0 to 2 percent slopes.....	1,094	.2			
Dungeness fine sandy loam, shallow, 0 to 2 percent slopes.....	243	(1)			

See footnotes at end of table.

material, and major characteristics of soil series—Continued

Internal drainage ¹	Surface soil		Subsoil			Approximate depth to substratum
	Color ²	Consistence ³	Color ²	Texture	Consistence ³	
Medium	Reddish brown	Friable	Reddish brown	Clay loam	Firm	20-32
Very rapid	Brown to reddish brown	Very friable	Light brown	Sandy loam or loamy sand	Loose	10-24
Medium	Brown	Friable	Reddish brown	Silt loam or silty clay loam	Firm	40-50
Medium	Light brownish-gray	Friable	Gray	Silt loam	Friable to firm	26-36
Very rapid	Light brownish-gray	Loose	Gray	Sand to gravel	Loose	8-18
Slow	Light brownish-gray	Friable	Gray	Silt loam or silty clay loam	Firm	20-26
Slow	Dark grayish brown to grayish brown	Friable	Grayish brown	Silt loam	Friable	32-46
Slow	Dark grayish brown	Friable	Light brownish gray	Silty clay	Firm	40-48

³ Consistence of subsoil when moist.

TABLE 3.—Approximate acreage of soils in Mason County, Wash.—Continued

Soil	Acre	Percent	Soil	Acre	Percent
Grove gravelly sandy loam, basin phase, 0 to 5 percent slopes	396	0.1	Juno loam, 0 to 3 percent slopes	354	0.1
Harstine gravelly sandy loam, 5 to 15 percent slopes	6,452	1.0	Juno gravelly sandy loam, 0 to 3 percent slopes	415	.1
Harstine gravelly sandy loam, 15 to 30 percent slopes	925	.1	Juno loamy sand, 0 to 3 percent slopes	105	(1)
Hoodsport gravelly sandy loam, 5 to 15 percent slopes	13,762	2.2	Kitsap silt loam, 5 to 15 percent slopes	697	.1
Hoodsport gravelly sandy loam, 0 to 5 percent slopes	400	.1	Kitsap silt loam, 0 to 5 percent slopes	166	(1)
Hoodsport gravelly sandy loam, 15 to 30 percent slopes	2,685	.4	Kitsap silt loam, 15 to 30 percent slopes	219	(1)
Hoodsport gravelly sandy loam, 30 to 45 percent slopes	9,053	1.5	Kitsap silty clay loam, 0 to 5 percent slopes	435	.1
Hoodsport stony sandy loam, 5 to 15 percent slopes	5,601	1.0	Kitsap silty clay loam, 5 to 15 percent slopes	102	(1)
Hoodsport stony sandy loam, 15 to 30 percent slopes	4,211	.7	Koch gravelly loam, 0 to 3 percent slopes	276	(1)
Hoquiam silt loam, 5 to 15 percent slopes	5,311	1.0	Koch silt loam, 0 to 3 percent slopes	65	(1)
Hoquiam silt loam, 0 to 5 percent slopes	506	.1	Koch gravelly sandy loam, 0 to 3 percent slopes	59	(1)
Hoquiam silt loam, 15 to 30 percent slopes	285	(1)	Le Bar silt loam, 0 to 5 percent slopes	1,693	.3
Hoquiam gravelly silt loam, 5 to 15 percent slopes	3,805	.6	Lystair sandy loam, 0 to 5 percent slopes	761	.1
Hoquiam gravelly silt loam, 15 to 30 percent slopes	3,365	.5	Lystair sandy loam, 5 to 15 percent slopes	558	.1
Hoquiam loam, 15 to 30 percent slopes	600	.1	Lystair loamy sand, 0 to 5 percent slopes	220	(1)
Hoquiam and Astoria silt loams, 5 to 15 percent slopes	229	(1)	Lystair loamy sand, 5 to 15 percent slopes	329	.1
Hoquiam and Astoria silt loams, 15 to 30 percent slopes	210	(1)	Made land	162	(1)
Indianola loamy sand, 5 to 15 percent slopes	2,267	.4	Maytown silt loam, 0 to 3 percent slopes	2,627	.4
Indianola loamy sand, 0 to 5 percent slopes	415	.1	McKenna gravelly loam, 0 to 3 percent slopes	741	.1
Indianola loamy sand, 15 to 30 percent slopes	354	.1	McKenna loam, 0 to 3 percent slopes	192	(1)
Indianola sandy loam, 0 to 5 percent slopes	471	.1	McMurray peat, 0 to 2 percent slopes	1,902	.3
Indianola sandy loam, 5 to 15 percent slopes	574	.1	McMurray peat, shallow over gravel, 0 to 2 percent slopes	555	.1
Juno sandy loam, 0 to 3 percent slopes	668	.1	Mukilteo peat, 0 to 2 percent slopes	4,401	.7
			Mukilteo peat, shallow over gravel, 0 to 2 percent slopes	736	.1
			Nasel gravelly loam, 0 to 5 percent slopes	121	(1)
			Nordby loam, 0 to 5 percent slopes	618	.1
			Nordby loam, 5 to 15 percent slopes	116	(1)
			Norma silt loam, 0 to 3 percent slopes	818	.1
			Norma sandy loam, 0 to 3 percent slopes	153	(1)
			Nuby silt loam, 0 to 3 percent slopes	694	.1
			Oreas peat, 0 to 2 percent slopes	576	.1
			Oreas peat, shallow over gravel, 0 to 2 percent slopes	68	(1)

See footnotes at end of table.

TABLE 3.—*Approximate acreage of soils in Mason County, Wash.—Continued*

Soil	Acres	Percent	Soil	Acres	Percent
Pilchuck gravelly loamy sand, 0 to 3 percent slopes	426	0 1	Sinclair shotty loam, 15 to 30 percent slopes	943	0 2
Pilchuck loamy sand, 0 to 3 percent slopes	290	(1)	Sinclair shotty clay loam, 0 to 5 percent slopes	245	(1)
Pilchuck sand, shallow, 0 to 3 percent slopes	175	(1)	Skokomish silt loam, 0 to 3 percent slopes	955	.2
Puget silt loam, 0 to 2 percent slopes	615	1	Sol Duc gravelly loam, 0 to 5 percent slopes	3,460	.6
Riverwash, 0 to 3 percent slopes	592	1	Sol Duc gravelly loam, 5 to 15 percent slopes	666	.1
Rough broken land	6,118	1 0	Sol Duc gravelly sandy loam, 0 to 5 percent slopes	3,190	.5
Rough mountainous land, Hoodsport soil material	8,066	1 3	Stimson silt loam, 0 to 2 percent slopes	82	(1)
Rough mountainous land, Tebo soil material	48,881	8 0	Tacoma peat, 0 to 2 percent slopes	273	(1)
Rough mountainous land, Tebo-Shelton complex	1,733	.3	Tanwax peat, 0 to 2 percent slopes	351	.1
Saxon silt loam, 5 to 15 percent slopes	381	.1	Tanwax peat, shallow over gravel, 0 to 2 percent slopes	188	(1)
Semiahmoo muck, 0 to 2 percent slopes	161	(1)	Tebo loam, 5 to 15 percent slopes	163	(1)
Semiahmoo muck, shallow, 2 to 10 percent slopes	132	(1)	Tebo loam, 15 to 30 percent slopes	834	.1
Shelton gravelly sandy loam, 5 to 15 percent slopes	38,850	6 3	Tebo gravelly loam, 5 to 15 percent slopes	890	.1
Shelton gravelly sandy loam, 0 to 5 percent slopes	881	.1	Tebo gravelly loam, 15 to 30 percent slopes	1,240	.2
Shelton gravelly sandy loam, 15 to 30 percent slopes	6,897	1 1	Tebo gravelly loam, 30 to 45 percent slopes	100	(1)
Shelton gravelly sandy loam, 30 to 45 percent slopes	1,859	.3	Tebo-Astoria complex, 5 to 15 percent slopes	197	(1)
Shelton gravelly loam, 5 to 15 percent slopes	2,737	4	Tebo Astoria complex, 15 to 30 percent slopes	130	(1)
Shelton-Astoria complex, 5 to 15 percent slopes	690	.1	Tidal marsh, 0 to 2 percent slopes	902	.1
Shelton-Astoria complex, 15 to 30 percent slopes	169	(1)	Wadell gravelly loam, 0 to 5 percent slopes	456	.1
Sinclair shotty loam, 5 to 15 percent slopes	4,991	8	Wadell gravelly loam, 5 to 10 percent slopes	612	1
			Wadell loam, 0 to 5 percent slopes	44	(1)
			Wapato silt loam, 0 to 3 percent slopes	780	1
			Wapato silty clay loam, 0 to 3 percent slopes	50	(1)
			Area of soils mapped	444,160	71 8
			National forest and National park not mapped	174,720	28 2
			Total	618,880	100 0

¹ Less than 0.1 percent

TABLE 4.—Important characteristics of soils of Mason County, Wash.

Soil	Natural drainage	Occurrence of high water table	Moisture-supplying capacity ¹	Root penetration limited by—	Depth to layer that limits root penetration ²	Natural fertility
Alderwood gravelly sandy loam, 5 to 15 percent slopes.	Good	None	Fair	Cemented till	Moderately shallow	Low
Alderwood gravelly sandy loam, 15 to 30 percent slopes.	Good	None	Low	Cemented till	Moderately shallow	Low
Alderwood gravelly sandy loam, 30 to 45 percent slopes.	Good	None	Fair to good	Cemented till	Moderately shallow	Low
Alderwood gravelly loam, 5 to 15 percent slopes.	Good	None	None	Bedrock	Deep	Low
Astoria silt loam, 15 to 30 percent slopes.	Good	None	Good	Bedrock	Deep	Low
Astoria silt loam, 5 to 15 percent slopes.	Good	None	Good	None	Moderately deep	Medium
Belfast sandy loam, 0 to 3 percent slopes.	Moderately good	Oasionally in winter	Fair	None	Moderately deep	Medium
Belfast silt loam, 0 to 3 percent slopes	Moderately good	Oasionally in winter	Good	None	Moderately deep	Medium
Belle silt loam, 0 to 5 percent slopes.	Good	None	Good	None	Deep	Medium
Bellingham silt loam, 0 to 3 percent slopes.	Poor	Yes	Good	Clay	Moderately deep	Medium
Bellingham silty clay loam, 0 to 3 percent slopes.	Poor	Yes	Good	Clay	Moderately deep	Medium
Carstairs gravelly loam, 0 to 5 percent slopes.	Somewhat excessive	None	Low	None	Moderately shallow to moderately deep	Low
Cloquallum silt loam, 5 to 15 percent slopes.	Moderately good	None	Good	None	Moderately shallow	Medium
Cloquallum silt loam, 0 to 5 percent slopes.	Moderately good	None	Good	None	Moderately shallow	Medium
Cloquallum silt loam, 15 to 30 percent slopes.	Moderately good	None	Good	None	Moderately shallow	Medium
Cloquallum silty clay loam, 5 to 15 percent slopes.	Moderately good	None	Good	None	Moderately shallow	Medium
Cloquallum silty loam, moderately shallow over cemented till, 5 to 15 percent slopes.	Moderately good	None	Good	Compact till	Moderately deep to deep	Medium
Coastal beach, 0 to 2 percent slopes.	Nonagricultural beachlime, consisting of sand and gravel	Poor	Yes	Fair	Coarse gravel	Medium
Deckerville gravelly loam, 0 to 2 percent slopes.	Deckerville silt loam, 0 to 2 percent slopes.	Poor	Yes	Good	Coarse gravel	Medium
Deckerville silty clay loam, 0 to 2 percent slopes.	Deckerville gravelly silty clay loam, 0 to 2 percent slopes.	Poor	Yes	Good	Coarse gravel	Medium
Deckerville gravelly loam, 15 to 30 percent slopes.	Deckerville gravelly loam, 0 to 2 percent slopes.	Poor	Yes	Good	Coarse gravel	Medium
Dungeness fine sandy loam, 0 to 2 percent slopes.	Dungeness fine sandy loam, 0 to 2 percent slopes.	Good	None	Fair	Compact till	Medium
Dungeness fine silt loam, 0 to 2 percent slopes.	Dungeness fine silt loam, 0 to 2 percent slopes.	Good	None	Fair	Compact till	Medium
Dungeness fine sandy loam, shallow, 0 to 2 percent slopes.	Dungeness fine sandy loam, shallow, 0 to 2 percent slopes.	Moderately good	Winter and spring	High	None	High
Edmonds fine sandy loam, 0 to 2 percent slopes.	Edmonds fine sandy loam, 0 to 2 percent slopes.	Moderately good	Winter and spring	High	Sand and gravel	Medium
Edmonds silt loam, 0 to 2 percent slopes.	Edmonds silt loam, 0 to 2 percent slopes.	Poor	Yes	High	Water table	Medium
Eld silt loam, 0 to 3 percent slopes.	Moderately good	Occasionally in winter	Good	Sand and gravel	Moderately deep	Medium

See footnotes at end of table.

TABLE 4.—Important characteristics of soils of Mason County, Wash.—Continued

Soil	Natural drainage ¹	Occurrence of high water table	Moisture-supplying capacity ¹	Root penetration limited by—	Depth to layer that limits root penetration ²	Natural fertility
Everett gravelly sandy loam, 5 to 15 percent slopes.	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Everett gravelly sandy loam, 0 to 5 percent slopes.	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Everett gravelly sandy loam, 15 to 30 percent slopes	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Everett gravelly loamy sand, 0 to 5 percent slopes.	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Everett gravelly loamy sand, 5 to 15 percent slopes.	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Everett gravelly loamy sand, 15 to 30 percent slopes.	Somewhat excessive.	None -----	Low -----	Coarse gravel.	Moderately deep.	Low -----
Grove gravelly sandy loam, 0 to 5 percent slopes	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly sandy loam, 5 to 15 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly sandy loam, 15 to 30 percent slopes	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly sandy loam, 30 to 45 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove cobbley sandy loam, 0 to 5 percent slopes	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove cobbley sandy loam, 5 to 15 percent slopes	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove cobbley sandy loam, 15 to 30 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove stony sandy loam, 0 to 5 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly loam, 0 to 5 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly loam, 5 to 15 percent slopes.	Somewhat excessive.	None -----	Low -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly loam, basin phase, 0 to 5 percent slopes.	Good -----	Good -----	Fair -----	Gravel -----	Moderately deep.	Low -----
Grove gravelly sandy loam, basin phase, 0 to 5 percent slopes.	Good -----	Good -----	Fair -----	Gravel -----	Moderately deep.	Low -----
Harstine gravelly sandy loam, 5 to 15 percent slopes.	Good -----	Good -----	Fair -----	Compact till.	Moderately deep.	Low -----
Harstine gravelly sandy loam, 15 to 30 percent slopes.	Good -----	Good -----	Low -----	Compact till.	Moderately deep.	Low -----
Hoodsport gravelly sandy loam, 5 to 15 percent slopes.	Good -----	Good -----	Fair to low.	Compact till.	Moderately deep.	Very low -----
Hoodsport gravelly sandy loam, 0 to 5 percent slopes.	Good -----	Good -----	None -----	Compact till.	Moderately deep.	Very low -----
Hoodsport gravelly sandy loam, 15 to 30 percent slopes.	Good -----	Good -----	None -----	Compact till.	Moderately deep.	Very low -----
Hoodsport gravelly sandy loam, 30 to 45 percent slopes.	Good -----	Good -----	None -----	Compact till.	Moderately deep.	Very low -----
Hoodsport stony sandy loam, 5 to 15 percent slopes.	Good -----	Good -----	None -----	Compact till.	Moderately deep.	Very low -----
Hoodsport stony sandy loam, 15 to 30 percent slopes.	Good -----	Good -----	None -----	Compact till.	Moderately deep.	Very low -----
Koquiam silt loam, 5 to 15 percent slopes.	Good -----	Good -----	None -----	High -----	Deep -----	Low -----

Hoquiam silt loam, 0 to 5 percent slopes-	Good	High	Compact till	Deep	Low
Hoquiam gravelly silt loam, 5 to 15 percent slopes.	Good	High	Compact till	Deep	Low
Hoquiam gravelly silt loam, 15 to 30 percent slopes.	Good	High	Compact till	Deep	Low
Hoquiam loam, 15 to 30 percent slopes.	Good	Good	None	Deep	Low
Hoquiam and Astoria silt loams, 5 to 15 percent slopes.	Good	High	Compact till	Deep	Low
Indiana loamy sand, 0 to 5 percent slopes.	Somewhat excessive,	High	Compact till	Deep	Low
Indiana loamy sand, 5 to 15 percent slopes.	Somewhat excessive,	High	Compact till	Deep	Low
Indiana loamy sand, 15 to 30 percent slopes.	Somewhat excessive,	High	Compact till	Deep	Low
Indiana sandy loam, 0 to 5 percent slopes.	Somewhat excessive,	High	Compact till	Deep	Low
Indiana sandy loam, 5 to 15 percent slopes.	Somewhat excessive,	High	Compact till	Deep	Low
Juno sandy loam, 0 to 3 percent slopes.	Somewhat excessive,	Low	None	None	Low
Juno loam, 0 to 3 percent slopes.	Somewhat excessive,	Low	None	None	Low
Juno gravelly sandy loam, 0 to 3 percent slopes.	Somewhat excessive,	Low	None	None	Low
Juno loamy sand, 0 to 3 percent slopes.	Somewhat excessive,	Low	None	None	Low
Kitsap silt loam, 5 to 15 percent slopes.	Moderately good,	Good	None	Shallow	Medium to low.
Kitsap silt loam, 0 to 5 percent slopes.	Moderately good,	Good	None	Shallow	Medium to low.
Kitsap silt loam, 15 to 30 percent slopes.	Moderately good,	Good	None	Shallow	Medium to low.
Kitsap silty clay loam, 0 to 5 percent slopes.	Moderately good,	Good	None	Shallow	Medium to low.
Koch gravelly loam, 0 to 3 percent slopes.	Imperfect to poor	Good	None	Shallow	Low
Koch silt loam, 0 to 3 percent slopes.	Imperfect to poor.	Good	None	Shallow	Low
Koch gravelly sandy loam, 0 to 3 percent slopes.	Good	Good	None	Shallow	Low
Le Bar silt loam, 0 to 5 percent slopes.	Somewhat excessive,	Good	None	Shallow	Low
Lystair sandy loam, 5 to 15 percent slopes.	Somewhat excessive,	Good	None	Shallow	Low
Lystair sandy loam, 15 to 30 percent slopes.	Somewhat excessive,	Good	None	Shallow	Low
Lystair loamy sand, 0 to 5 percent slopes.	Somewhat excessive,	Good	None	Shallow	Low
Lystair loamy sand, 5 to 15 percent slopes.	Somewhat excessive,	Good	None	Shallow	Low
Made land	Not suitable for agriculture	Good	None	Shallow	Low
Maytown silt loam, 0 to 3 percent slopes.	Good to moderately good	Occasionally in winter	None	Shallow	Moderately high.
McKenna gravelly loam, 0 to 3 percent slopes.	Good	In winter	Fair to good.	Gravel and high water table	Medium
McKenna loam, 0 to 3 percent slopes.	Good	In winter	Fair to good.	Gravel and high water table.	Medium

See footnotes at end of table.

TABLE 4.—*Important characteristics of soils of Mason County, Wash.*—Continued

Soil	Natural drainage	Occurrence of high water table	Moisture-supplying capacity ¹	Root penetration limited by—	Depth to layer that limits root penetration ²	Natural fertility
Mc Murray peat, 0 to 2 percent slopes	Very poor	Yes	Very high	High water table.	Shallow	High
Mc Murray peat, shallow over gravel, 0 to 2 percent slopes.	Very poor	Yes	Very high	High water table.	Shallow	High
Mukilteo peat, 0 to 2 percent slopes	Very poor	Yes	Very high	High water table and gravel.	Shallow	High
Mukilteo peat, shallow over gravel, 0 to 2 percent slopes.	Very poor	Yes	Very high	High water table.	Shallow	High
Nasel gravelly loam, 0 to 5 percent slopes.	Good	None	Fair	Gravel.	None	Medium
Nasel gravelly loam, 0 to 5 percent slopes.	Good	None	Fair	None	None	Medium to low
Nordby loam, 5 to 15 percent slopes	Good	None	Fair	None	Low	Low
Nordby loam, 5 to 15 percent slopes	Poor	None	Fair	None	Shallow	Medium
Norma sandy loam, 0 to 3 percent slopes.	Poor	In winter	High	High water table.	Shallow	Medium
Norma silt loam, 0 to 3 percent slopes	Poor	In winter	High	High water table.	Shallow	Medium
Nuby silt loam, 0 to 3 percent slopes	Poor to somewhat poor	In winter	High	High water table.	Shallow	Medium
Oreas peat, 0 to 2 percent slopes	Very poor	Yes	High (ponded)	Water table.	Shallow	Low
Oreas peat, shallow over gravel, 0 to 2 percent slopes.	Very poor	Yes	High (ponded)	Water table.	Shallow	Low
Pilchuck gravelly loamy sand, 0 to 3 percent slopes.	Somewhat excessive	Occasionally in winter.	Low	Sand.	Shallow	Low
Pilchuck loamy sand, 0 to 3 percent slopes.	Somewhat excessive	Occasionally in winter.	Low	Sand.	Shallow	Low
Pilchuck sand, shallow, 0 to 3 percent slopes.	Excessive	Occasionally in winter.	Very low	Sand.	Shallow	Low
Puget silt loam, 0 to 2 percent slopes	Poor	In winter	High	Clay and high water table	Moderately deep	High
Rough broken land	Excessive	None	Low	Gravel.	Shallow	Low
Rough, mountainous land, Hoodsoport soil material.	Good	None	Low	Cemented till.	Moderately deep	Low
Rough, mountainous land, Tebo soil material	Good	None	Fair	None	None	Low
Rough, mountainous land, Tebo-Shelton complex	Good	None	Fair	Variable	Variable	Low
Saxon silt loam, 5 to 15 percent slopes.	Good	None	Good	None	None	Medium
Semiahmoo muck, 0 to 2 percent slopes.	Very poor	Yes	Very high	Shallow	High	High
Semiahmoo muck, shallow, 2 to 10 percent slopes.	Very poor	Yes	Very high	Shallow	High	High
Shelton gravelly sandy loam, 5 to 15 percent slopes.	Good	None	Fair	Cemented till.	Moderately deep	Low
Shelton gravelly sandy loam, 5 to 15 percent slopes.	Good	None	Fair	Cemented till.	Moderately deep	Low
Shelton gravelly sandy loam, 15 to 30 percent slopes.	Good	None	Low	Cemented till.	Moderately deep	Low
Shelton gravelly sandy loam, 30 to 45 percent slopes.	Good	None	Fair	Cemented till.	Moderately deep	Low
Shelton gravelly loam, 5 to 15 percent slopes.	Good	None	Fair to good.	Compact till or bedrock.	Moderately deep	Low
Shelton-Astoria complex, 5 to 15 percent slopes.	Good	None	Fair to good.	Compact till or bedrock.	Moderately deep to deep.	Low
Shelton-Astoria complex, 15 to 30 percent slopes.	Good	None	Fair to good.	Compact till or bedrock.	Deep to deep.	Low

Sinclair silty loam, 5 to 15 percent slopes.	Moderately good.	None.....	Good to fair.	Cemented till deep.	Low
Sinclair silty loam, 15 to 30 percent slopes.	Moderately good.	None	Fair	Cemented till deep.	Low
Sinclair silty clay loam, 0 to 5 percent slopes.	Moderately good.	None	Good	Cemented till deep.	Low
Skokomish silt loam, 0 to 3 percent slopes.	Imperfect.....	Yes	Very high	Moderately deep.	High
Sol Duc gravelly loam, 0 to 5 percent slopes.	Good to somewhat excessive.	None	Fair to low	High water table	Low to medium.
Sol Duc gravelly loam, 5 to 15 percent slopes.	Good to somewhat excessive.	None	Fair to low	High water table	Low to medium
Sol Duc gravelly sandy loam, 0 to 5 percent slopes.	Somewhat excessive.	None	Low	High water table	Low
Stimson silt loam, 0 to 2 percent slopes	Poor.....	Yes	High	Clay.....	Moderately deep.
Tacoma peat, 0 to 2 percent slopes.....	Very poor.....	Yes	Very high	High water table	Shallow.....
Tanwax peat, 0 to 2 percent slopes.....	Very poor.....	Yes	Very high	High water table	Shallow.....
Tanwax peat, shallow over gravel, 0 to 2 percent slopes.	Very poor.....	Yes	Very high	High water table	Shallow.....
Tebo loam, 5 to 15 percent slopes.....	Good.....	None	Good	Gravel	Medium to low.
Tebo loam, 15 to 30 percent slopes.....	Good.....	None	Good	Bedrock	Low
Tebo gravelly loam, 5 to 15 percent slopes.	Good	None	Good	Bedrock	Low
Tebo gravelly loam, 15 to 30 percent slopes.	Good	None	Good	Bedrock	Low
Tebo gravelly loam, 30 to 45 percent slopes.	Good	None	Good	Bedrock	Low
Tebo-Astoria complex, 5 to 15 percent slopes.	Good	None	Good	Bedrock	Shallow to deep
Tebo-Astoria complex, 15 to 30 percent slopes.	Good	None	Good	Bedrock	Low
Tidal marsh, 0 to 2 percent slopes.....	Good	None	Good	Bedrock	Low
Wadell gravelly loam, 0 to 5 percent slopes.	Good	None	Good	Bedrock	Low
Wadell gravelly loam, 5 to 10 percent slopes.	Good	None	Good	Bedrock	Low
Wadell loam, 0 to 5 percent slopes.....	Good	None	Good	Bedrock	Low
Wapato silt loam, 0 to 3 percent slopes.	Poor.....	Yes	High	High water table	Moderately deep.
Wapato silty clay loam, 0 to 3 percent slopes.	Poor	Yes	High	High water table	Moderately deep.

¹ Refers to capacity to supply moisture that plants can use.

² Refers to the depths to which roots can readily penetrate. Very shallow (less

than 10 inches); shallow (10 to 20 inches), moderately deep (36 to 60 inches), deep (more than 60

ALDERWOOD SERIES

The Alderwood series consists of brown, well-drained, upland soils. They have developed from mixed gravelly glacial till dominated by acid igneous rock. The imbedded gravel is mainly granite and quartzite. Rainfall is 45 to 60 inches a year. The native vegetation is a dense forest consisting almost entirely of Douglas-fir and a dense understory of salal, Oregon-grape, vine maple, and huckleberry. Northeast of the Hood Canal the understory is mainly rhododendron. Alderwood soils occupy the extensive rolling glacial moraines, and they are the dominant soils in the eastern part of the county.

The Alderwood soils are associated with the somewhat excessively drained Everett and Indianola soils and with the moderately well drained Kitsap soils. Shelton and Hoodsport soils differ from the Alderwood soils in that they have developed under high rainfall and from glacial till having a much higher content of basic igneous rock. The Shelton and Hoodsport soils are more reddish throughout the profile. The Shelton soils are usually deeper to the cemented till than the Alderwood soils.

Alderwood gravelly sandy loam, 5 to 15 percent slopes (Ab).—This is the most extensive soil of the Alderwood series. It occupies undulating to rolling moraines.

In undisturbed areas a 1- to 2-inch mat of very dark brown, acid organic matter is on the surface. This grades to a thin, dark grayish-brown, highly organic mineral soil. The surface soil consists of a friable, brown,² medium acid gravelly sandy loam 8 to 13 inches deep. It has a weak granular structure and contains numerous rounded shot. Below the surface soil, to depths ranging from 18 to 24 inches, is a pale-brown gravelly sandy loam that is very friable, is single grained, and contains small to moderate amounts of shot (20). Between this layer and the cemented till is a 3- to 10-inch layer of very pale brown gravelly sandy loam. It contains no shot and is firmer but has the same texture as the layer above. However, it is faintly to distinctly spotted and horizontally streaked with brown and yellow. The cemented till consists of light-gray, gravelly sandy loam, and it normally occurs at depths ranging from 24 to 32 inches. It is impermeable to roots and very slowly permeable to water. The first few inches is usually laminated and streaked with reddish brown and yellow. Below this, to a depth of many feet, the till is uniformly cemented, fairly uniform light gray, and medium to strongly acid. A thin mat of roots often lies over the till.

The cemented substratum tends to restrict the rapid downward movement of moisture.

Use and suitability.—Not more than about 5 percent of this soil has been cleared and is used for crops or pasture. Most of the cultivated acreage is near the inlets of Puget Sound in the vicinities of Arcadia and Allyn. In this area the Alderwood soils are associated with the better agricultural soils of the Cloquallum, Sinclair, and Kitsap series.

Hay, small grains, pasture, fruits, nuts, grapes, and berries are the principal crops grown on the Alderwood soils. The lack of subsoil moisture damages crops in summer. For this reason, early maturing, short-season crops are suited best to this soil. Yields of all crops are usually fairly low because of low fertility and the

dry summers. Pastures produce good forage in spring and late in fall if proper plants are used and management is good. The deeper soils are suited best to fruits, nuts, and grapes. The uncleared and remote areas are better suited to forestry than to cultivated crops.

Nearly all the uncleared acreage is in second-growth forest 70 to 80 years of age. Shallowness to the compact till often inhibits growth of the older trees. The soil, however, is well suited to production of Christmas trees. Douglas-fir readily restocks in thick stands containing trees of good form. Stands of small trees are often thinned and pruned to maintain good form of growth. The growing of Christmas trees has expanded rapidly in the past few years and is now one of the important industries in the county. It is one of the proper uses of the cutover lands that are not in a high site class.

Alderwood soils need barnyard manure, green manure, nitrogen, or legumes to maintain a fertility for crop production. Phosphate fertilizers and green manure or barnyard manure greatly improve fertility. Nitrogen fertilizer is often applied with barnyard manure or when cover crops are plowed under. The fertilizer furnishes additional nitrogen needed to hasten decay of the organic matter.

This soil is in capability subclass VIIs and in site classes 4 and 5 for Douglas-fir. Small areas along the border, where the soil is more than 32 inches deep to compact till, are in site classes 3 and 4 for Douglas-fir.

Alderwood gravelly sandy loam, 15 to 30 percent slopes (Ac).—This soil varies more in depth, but otherwise it is similar to Alderwood gravelly sandy loam, 5 to 15 percent slopes. It occurs in close association with and adjacent to that soil. It is on moderately steep ridges, along drainageways, and on elongated irregular slopes. Small areas with slopes of more than 30 percent are mapped with this soil. Surface drainage is more rapid than on the more gentle slopes. Runoff and erosion on the logged and semicleared areas are controlled by the dense growth of plants. Erosion would damage the soil if it were cleared for crops.

Use and suitability. The moderately steep and irregular relief make this soil unsuitable for cultivation. It should be used only for forestry. In most respects tree growth is similar to that on Alderwood gravelly sandy loam, 5 to 15 percent slopes, but growth differs according to the direction of slope and local drainage along the channels of small streams. Areas along streams usually have a prolific growth of alder that tends to retard the restocking of Douglas-fir. This soil is in capability subclass VIIs and in site classes 4 and 5 for Douglas-fir.

Alderwood gravelly sandy loam, 30 to 45 percent slopes (Ad).—This soil is similar to and adjacent to other Alderwood soils. It occupies gullies and deeply cut banks of streams. Few of the profile characteristics are uniform. The depth to till, content of gravel, and nature of the material vary considerably from place to place.

Use and suitability.—This soil is used only for forestry, and it should be left in that use. It is in capability subclass VIe and in site class 5 for Douglas-fir.

Alderwood gravelly loam, 5 to 15 percent slopes (Ag).—This soil differs from Alderwood gravelly sandy loam, 5 to 15 percent slopes, mainly in having a surface soil and subsoil that are gravelly loam. In addition, the

² Unless otherwise stated, the color is that of dry soil

depth to compact till is more variable and often deeper and the soil generally is slightly darker. In some areas the development of this soil has been influenced by small amounts of lake sediments similar to those from which the Cloquallum and Kitsap soils are forming. These sediments are the cause of profile variations within short distances. The capacity of this soil to hold water is greater than that of the more coarsely textured Alderwood soils. Consequently, yields of crops are higher, and this soil is more suitable for crops.

Use and suitability.—Nearly all of this soil is forested. Accessible areas could be cleared and cultivated. The management of them would be similar to that of Alderwood gravelly sandy loam, 5 to 15 percent slopes. Yields of crops could be slightly higher because of greater moisture-holding capacity.

This soil is in capability subclass IVs and in site classes 4 and 5 for Douglas-fir.

ASTORIA SERIES

The Astoria series consists of permeable, dark-brown, well-drained residual soils that have developed from deeply weathered shale and argillaceous sandstone. They have developed under a dense forest of Douglas-fir, western hemlock, and scattered spruce and cedar. The ground cover is very dense. The rainfall is 70 to 95 inches per year. The soils are very strongly acid and are more acid with depth. Their excellent structure allows them to absorb water readily. The subsoil may be saturated during winter when rain is plentiful.

The Astoria soils are on the steeply rolling foothills northwest of Matlock in the extreme western part of the county and in low mountainous areas along the southwestern boundary of the county.

Astoria silt loam, 15 to 30 percent slopes (Af).—This soil occurs on hilly terrain where some slopes are as much as 45 percent. On the surface is a 1- to 3-inch, very acid mat of leaves, twigs, and humus. The upper 3 to 5 inches of soil is a dark-brown, friable silt loam of moderate, fine, granular structure. This layer is fairly high in organic matter and strongly acid. Under this is a 10- to 12-inch layer of dark grayish-brown, granular, friable to firm, light silty clay loam that contains a few soft shot. This material grades to a firm subsoil layer of silty clay loam. This subsoil is streaked with brown and yellowish brown and has a subangular blocky structure. There is a fairly sharp separation between this layer of subsoil and the next layer, which is a brownish-yellow, firm silty clay loam containing yellow and pale-brown particles of partly disintegrated parent material. At depths ranging from 32 to 45 inches, this material grades abruptly to mottled yellow and yellowish-brown, partly disintegrated, soft, sharp, angular fragments of shale and argillaceous sandstone. The fragments are fairly hard when dry but smooth and silty when moist. Their surfaces are stained yellowish brown, orange, and red. These angular fragments form small talus slides on the slopes of deep cuts.

Use and suitability.—Very little of this soil has been cleared or is being farmed. Most of the acreage is hilly, inaccessible, and in forest. The soil is excellent for forestry. Most logged areas have reforested. Maple and alder readily restock logged areas and retard reforestation with Douglas-fir. These areas usually have a less

dense ground cover and are more favorable for grazing. The very dense forest vegetation prevents serious erosion.

This soil is in capability subclass VIe and in site classes 1 and 2 for Douglas-fir.

Astoria silt loam, 5 to 15 percent slopes (Ae).—This soil is similar to and closely associated with Astoria silt loam, 15 to 30 percent slopes. No large, continuous areas occur in the county. The soil has favorable texture, structure, and capacity to hold available moisture, but it is infertile and strongly acid.

Use and suitability.—Most of this soil is not accessible, but a few isolated areas are farmed with other soils. The rest is in forest. Large quantities of lime and fertilizer are needed for satisfactory yields of crops.

This soil is in capability subclass VIe and in site classes 1 and 2 for Douglas-fir.

BELFAST SERIES

The Belfast series consists of moderately well drained, slightly to medium acid, brown alluvial soils that lie along smaller streams. Their parent material is washed mainly from surrounding areas of Vashon glacial drift. The native vegetation is a mixture of Douglas-fir, cedar, maple, willow, alder, vine maple, swordfern, shrubs, and grasses.

During winter the water table is close to the surface, and some areas are flooded during high water. Soil texture and depth to underlying gravel change within short distances. Coarse sand, with or without gravel, is at depths ranging from 2½ to 4 feet. Large areas of any one texture are few.

The soils are in small areas, mainly in the northeastern part of the county along the many small streams. In some areas these Belfast soils differ from the Juno soils only in depth to underlying gravel. The Belfast soils differ from other alluvial soils of the county mainly in having parent material that was deposited during the Vashon glaciation.

Belfast sandy loam, 0 to 3 percent slopes (Bq).—This soil is mainly along the Tahuya and Union Rivers. It is closely associated with Belfast silt loam and with Juno soils.

The surface soil is brown, friable, weak, granular sandy loam, 6 to 10 inches thick. The color is lighter with increasing depth. The subsurface to 15 inches is slightly lighter colored and a friable sandy loam. Below the depths of 15 to 25 inches is pale-brown, friable, sandy loam subsoil faintly mottled with yellow and rust brown. This material is underlain by stratified, light brownish-gray silt, fine sand, and sand. At depths of 42 to 50 inches but, in places at less depth, the silt and sand rest on well-rounded glacial gravel or very coarse sand.

The subsoil in areas along Union River normally is more intensively mottled with yellow and stained by iron, and the underlying material is coarse sand rather than gravel. About 100 acres having a loamy sand surface texture were mapped with this soil.

The soil does not waterlog, and normally it holds enough moisture to mature crops. Streaks of dried grass indicate places where sand or gravel is fairly near the surface.

Use and suitability.—About half the acreage, mainly areas along the lower reaches of the Tahuya and Union

Rivers, has been cleared and is farmed along with other soils. The uncleared acreage provides some grazing. Yields are good for the main crops grown—hay, small grains, and pasture.

All available barnyard manure should be put on the soil. Yields can be substantially increased through the occasional use of nitrogen fertilizer. Phosphate also improves yields. Other fertilizers are seldom used. The soil has a fairly high inherent fertility. Its use for agriculture is limited because it is in fairly small patches surrounded, in many places, by the shallower Junc soils or by other less desirable soils; because it is fairly difficult to reach; and because the cost of clearing it is high.

This soil is in capability subclass IIIIs and it is fair for mixed forests.

Belfast silt loam, 0 to 3 percent slopes (B₃).—This soil is inextensive and is closely associated with Belfast sandy loam, 0 to 3 percent slopes. The surface layer is a brown, friable silt loam, 8 to 14 inches thick, that becomes pale brown with increase in depth. Stratified sands and silts are below depths of 20 to 30 inches. Gravel usually is at depths of less than 4 feet.

Use and suitability.—Management is similar to that of Belfast sandy loam, 0 to 3 percent slopes. However, the soil has a higher capacity to hold moisture that plants can use, and yields of crops are better. It is in rather small, isolated areas, and this limits its use for crops.

This soil is in capability subclass IIIIs; it is fair for mixed forests.

BELLE SERIES

The Belle series consists of deep, well-drained, moderately permeable, brown and dark grayish-brown alluvial soils. The parent material is mainly reworked Astoria or Hoquiam soil material, but, locally, some material from Tebo soils is included. The dark color typical in most areas is caused by dominance of Astoria material. Where Hoquiam parent material is dominant, the soils are more brown throughout the profile. The texture is uniform throughout the profile. The vegetation is a dense forest of maple, alder, and cedar. The Belle soil mapped in this county occurs in the southwestern part, where it is associated with Astoria and Hoquiam soils.

Belle silt loam, 0 to 5 percent slopes (B_c). This soil occupies very gently sloping alluvial fans, mostly as small isolated areas bordered on three sides by hilly terrain.

The surface soil is a dark grayish-brown, moderately granular and friable, fine silt loam, 4 to 7 inches thick. It is underlain by 5 to 7 inches of friable silt loam of weak, granular structure. The layer is pale brown when dry and dark grayish brown when moist. It grades to a friable, brown, very faintly mottled, heavy silt loam subsoil with a strong, fine, subangular blocky structure. The substratum, beginning at depths of 30 to 40 inches, is a friable, faintly mottled, light yellowish-brown silty clay loam or silt loam.

Small fragments of soft shale are often scattered throughout the lower subsoil. Where the parent material was largely Hoquiam material, the surface soil and upper subsoil range from loam to a fine sandy loam and the profile is brown throughout.

The capacity to hold available moisture is good. Additional moisture for crops is obtained through seepage

from surrounding slopes. Gradients are strong enough for good surface drainage.

Use and suitability.—Most of the soil is uncleared or only partly cleared and is used as woodland pasture and for grazing. The few small areas in farms are in grass hay or pasture; oats are grown in some places for grain or hay. The use of this soil for farming is limited by the way the lower lying valley soils are used.

The soil is in capability subclass IIIIs; it is fair for mixed forests consisting of red alder, Oregon-maple, willow, spruce, and redcedar.

BELLINGHAM SERIES

The Bellingham series consists of poorly drained, very dark gray silty soils. They occupy upland depressions and glacial lake basins. They have developed from glacial materials under rainfall ranging from 45 to 60 inches per year. The native vegetation is a dense forest of alder, maple, willow, cedar, and an occasional spruce and aspen. Under the forest is spirea and a dense growth of wild rose, sedges, and water-tolerant grasses and shrubs. Bellingham soils are medium acid and high in organic matter. They are associated with the Kitsap and Cloquallum soils and with other glacial soils of the uplands.

Bellingham silt loam, 0 to 3 percent slopes (B_d).—This soil is widely distributed over the eastern part of the county and is associated with the Cloquallum soils. On the islands of Case Inlet and Pickering Passage and bordering the mainland, it is associated with the Kitsap soils.

The surface soil is a granular and friable, very dark gray silt loam, 6 to 10 inches thick. It contains much organic matter and many small roots. When moist, it is nearly black, and in many places it is covered by a thin peaty layer. Under the surface soil is a plastic silt loam or silty clay loam, 4 to 8 inches thick. This layer contains fewer roots and less organic matter than the layer above it. At depths ranging from 10 to 16 inches, the silt loam or silty clay loam grades sharply to a light-gray clay mottled with yellow, brownish yellow, and rust brown. The clay is hard when dry, plastic when wet, and firm when moist. It breaks into fine aggregates of subangular shape. From a depth of 24 to 30 inches and down to 48 to 72 inches, the substratum is light-gray to dark-gray silt loam, clay, or sandy clay. This material is faintly mottled with yellowish brown to bluish gray and is very plastic, dense, and massive. Below depths of 48 to 72 inches, the substratum rests on glacial lake sediments or drift.

Areas of this Bellingham soil joining areas of Cloquallum or Kitsap soils have a lighter colored surface soil and a less distinctly mottled subsoil. In many places the transition from this soil to Cloquallum or Kitsap soils is gradual.

The soil is wet and swampy if not drained. Dense clay in the subsoil prevents the use of tile for drainage, but excess surface water can be removed by using regularly spaced ditches in fields and at the bases of slopes.

Use and suitability.—When adequately drained, this soil is suited to hay, pasture, oats, and truck crops. It is moderately fertile and productive and retains moisture well in summer. Yields depend on adequate drainage as

well as on seasonal moisture. Excessive rain late in spring or early in summer causes crops to fail.

Hay and oats are the main crops. Truck crops are not grown extensively because of the distance to market. Permanent pastures can be grazed well into the summer and, in many seasons, all summer long.

This soil is not suited to fruits, nuts, or grapes. A few plantings of blueberries have been made, although they are not suited to this fine-textured soil. Blackberries grow well, but the soil is too wet for the other kinds of berries. Reed canarygrass is suited to areas that are difficult to drain.

Ordinarily, fertilizer other than barnyard manure is not used. Most crops benefit when manure treated with phosphate is applied. Truck crops receive a complete fertilizer. Lime is rarely used on crops.

This soil is in capability subclass IVw; it is fair for red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

Bellingham silty clay loam, 0 to 3 percent slopes (Be).—Most of this soil is on Squaxin Island and on other islands off Pickering Passage. It is closely associated with Bellingham silt loam, 0 to 3 percent slopes, but differs from it in having a finer textured surface soil and upper subsoil. The lower subsoil is very dense, and 24 to 34 inches from the surface it rests on dense clay sediments or drift. This soil is also closely associated with the Kitsap soils.

Use and suitability.—This soil is more difficult to drain than Bellingham silt loam, 0 to 3 percent slopes, and is more dense if worked under adverse moisture conditions. Otherwise, it is similar to that soil in use, crops, and yields.

This soil is in capability subclass IVw; it is fair for red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

CARSTAIRS SERIES

The Carstairs series consists of very dark, excessively drained soils. They occupy the nearly treeless outwash plains in the southwestern part of the county (fig. 3). In position and parent material, they are similar to the Grove soils. Carstairs soils have developed from basic parent material and under rainfall that ranges from 60 to 90 inches a year. The native vegetation consists of grass, kinnikinnick, ferns, moss, and low shrubs. Although the soil is surrounded by dense forests, it has no overstory, except for a few lodgepole pines, Douglas-firs, and clumps of Oregon-oak.

Carstairs soils are friable, shot free, gravelly, porous, and droughty. They resemble the Grove soils in being porous, droughty, and gravelly. They are finer textured than the Spanaway soils (not mapped in Mason County) and grade more gradually to the very loose and porous gravelly subsoil and substratum.

Carstairs gravelly loam, 0 to 5 percent slopes (Cc).—The surface soil is a friable, fluffy, very dark gray gravelly loam, about 7 inches thick. It has a weak, fine, granular structure; contains no shot; and, when moist, is nearly black or very dark brown. The subsurface layer, between depths of 7 and 15 inches, is a friable, dark-brown gravelly loam. It has a very weak, fine, granular structure and contains more gravel than the surface layer. The subsoil, extending to a depth of 25 inches, is a very friable, brown gravelly sandy loam. It is single grained



Figure 3.—The prairie is on Carstairs gravelly loam, 0 to 5 percent slopes. The forest in background is on Grove gravelly sandy loam, 0 to 5 percent slopes.

and, in places, is weakly compact. The gravel is stained with reddish brown and yellow. Below 25 inches is the substratum, which consists of loose, stratified, multicolored sandy gravel containing many cobbles and a few stones. Manganese and iron stains are on the surface of some of the stones.

This soil has a few slopes greater than 5 percent. The depth to the substratum ranges from 25 to 50 inches. In a few areas the solum contains small amounts of gravel and the surface soil is a sandy loam that is more coarse at a greater depth. At a depth of 30 inches, the texture grades to a loamy sand, or to sand. Near the surface, the soil is very strongly acid, but the subsurface layer is medium acid.

Use and suitability.—This soil is used mainly for pasture. It is too droughty and low in fertility for most cultivated crops. Part of the acreage is used for building sites and an airport. Small acreages are used for hay, pasture, and small grains. Yields are low and crop failures are frequent.

This soil is in capability subclass VI₁s and in site classes 3 and 4 for Douglas-fir.

CLOQUALLUM SERIES

The Cloquallum series consists of moderately well drained, brown upland soils. They occupy gently undulating to rolling areas where surface drainage is fairly well established. They have developed from silty sediments that washed from the southwestern terminal moraine and were deposited in glacial lakes formed when

the Vashon glacier retreated. The glacial sediment contained considerable amounts of local basic material that gave the soil a reddish cast. Rainfall ranges from 50 to 70 inches a year. The native vegetation is a luxuriant forest consisting mainly of Douglas-fir, though there are smaller areas of maple and alder. The understory is mainly salal.

Internal drainage is retarded by firm or slightly compact, slightly stratified silt and clay in the lower subsoil and substratum. The soils are medium acid.

The Cloquallum soils are in the central and south-central parts of the county, particularly on the sides of valleys originating in the Black Hills. Fairly broad areas extend out on the glacial plain. The Cloquallum soils are associated mainly with the Shelton and the Grove soils, but to a small extent they occur with the Alderwood and the Everett soils.

Cloquallum silt loam, 5 to 15 percent slopes (Cc).—This soil is readily accessible and is the most extensive in the series. It is gently rolling to rolling. The surface soil is a medium acid, friable, moderately granular, pale-brown to brown silt loam that is 8 to 12 inches thick. It contains a moderate amount of rounded shot that are pale brown on the outside but reddish brown on the inside. The subsurface layer is friable, more coarsely granular, pale-brown and reddish-brown silt loam ranging from 1 to 12 inches in thickness. This layer contains less shot than the surface layer, and it is faintly mottled with yellowish brown. Its thickness is fairly uniform in some areas but extremely variable in others. The subsurface layer grades to a subsoil of light-brown to brown silt loam that is mottled with very pale brown and light reddish brown. It is firm, contains no shot, and is more clayey than the surface soil. At depths of 24 to 28 inches the silt loam grades to firm, very pale brown and brownish-yellow, laminated silt, light clay, and very fine sand. The root channels are stained with rust brown, and the laminated planes, with yellowish brown.

Areas are included in which the profile is influenced by gravelly glacial drift. Gravel is scattered throughout the soil.

Water and roots penetrate the substratum slowly. The soil becomes more acid with depth and is strongly acid in the substratum.

Use and suitability.—This soil is one of the better upland soils in the county. About 15 to 20 percent of the acreage has been cleared, and more of it is being cleared. It is seldom the dominant soil in a large area, but occasionally it is in areas large enough for a farm unit. It holds enough moisture available to allow most crops to mature. Pastures are damaged to some degree in dry weather. On moderate slopes, runoff and erosion are not serious hazards.

The main crops are hay, grain, fruit, filberts, and berries. Vegetables are grown for home use or local markets. Yields are higher than from most other upland soils, but they are not so good as those from most of the alluvial and bottom-land soils.

Newly cleared areas are low in nitrogen and organic matter, and they should be planted to clover for 2 or 3 years before they are used for other crops. When the soil is in cultivation, supplies of nitrogen and organic matter should be maintained through the use of legumes

in crop rotations and the application of barnyard manure or of commercial fertilizer and green manure. Phosphate is also beneficial. In some places lime is needed to start clover on newly cleared areas.

The soil is better for growing timber than for growing Christmas trees. Uneleared areas produce Douglas-fir that is excellent sawtimber.

This soil is in capability subclass IVe and in site classes 2 and 3 for Douglas-fir.

Cloquallum silt loam, 0 to 5 percent slopes (Cb).—The surface drainage of this soil is less well established than that of Cloquallum silt loam, 5 to 15 percent slopes, but this soil does not become waterlogged or excessively wet. Its capacity to hold available moisture is good.

Use and suitability.—Management of this soil is the same as that for Cloquallum silt loam, 5 to 15 percent slopes. This soil, however, is better for farming and forestry because slopes are more even and uniform.

This soil is in capability subclass IIIIs and in site classes 2 and 3 for Douglas-fir.

Cloquallum silt loam, 15 to 30 percent slopes (Cd).—This soil occupies gullied areas and complex hilly slopes adjacent to other Cloquallum soils. Short slopes up to 40 percent are included. The areas are smaller and more irregular in shape than those of the other Cloquallum soils. This soil differs from Cloquallum silt loam, 5 to 15 percent slopes, in having a less uniform profile. Horizons are less clearly defined, and there are scattered gravelly patches and areas that are shallow over till.

The dense forest and ability of the soil to absorb moisture prevent erosion. Serious erosion could occur if the soil were cultivated and became saturated by heavy rains. Runoff is more rapid than from the less sloping Cloquallum soils.

Use and suitability.—The slopes are too steep for farming, and cultivation probably would cause serious erosion. A few short slopes are farmed along with less strongly sloping areas. Nearly all of this soil is in second-growth Douglas-fir mixed with cedar and an occasional hemlock. Large acreages are covered completely by maple, willow, and alder that have little value. Forests are noticeably better than on most adjacent soils.

This soil is in capability subclass VIe and in site classes 2 and 3 for Douglas-fir.

Cloquallum silty clay loam, 5 to 15 percent slopes (Cf).—This soil is fairly similar to and closely associated with Cloquallum silt loam, 5 to 15 percent slopes. The surface soil is friable and granular, pale-brown to light-brown silty clay loam. The upper subsoil, extending to depths of 20 to 28 inches, is a firm, pale-brown silty clay loam that is faintly mottled with yellowish brown. It has a subangular blocky structure. Both horizons contain moderate amounts of shot. The lower subsoil and the substratum have a slightly finer texture than that of the Cloquallum silt loams.

Surface drainage is well established but not excessive. The soil absorbs water readily, and it has a good capacity to hold moisture. Little runoff occurs, except under extreme conditions. Internal drainage is slightly retarded but not enough to keep the soil from becoming waterlogged. Roots slowly penetrate the subsoil and substratum.

Use and suitability.—This soil can be used the same as Cloquallum silt loam, 5 to 15 percent slopes; yields

are about the same. The finer texture of this soil allows less range in tillage, but the soil still can be worked throughout a fairly wide range of moisture content. Under good management, this soil is slightly better for hay than Cloquallum silt loam, 5 to 15 percent slopes.

This soil is in capability subclass IVe and in site classes 2 and 3 for Douglas-fir.

Cloquallum silt loam, moderately shallow over cemented till, 5 to 15 percent slopes (Ce).—This soil is closely associated with other Cloquallum soils. It occurs mainly on the outer fringes of the Cloquallum silt deposits, where glacial lakes were too shallow or time was too short for the glacial drift to have been completely or deeply covered by silt. This soil consists of silty sediment slightly mixed with Shelton or Alderwood soil material and resting on glacial drift. The deposits of silt are irregular in depth, and local disturbances have often mixed them with the underlying material.

The surface soil consists of friable, granular, pale-brown silt loam, 8 to 10 inches thick. It has a slight reddish cast and contains scattered gravel and a moderate amount of silt. The subsoil, which reaches to depths of 20 to 32 inches, is pale-brown or light reddish-brown silt loam, gritty silt loam, or clay loam. The content of subangular basaltic and rounded glacial gravel changes within short distances. At depths of 2 to 4 feet the soil rests upon light-gray, weakly cemented, gravelly till.

Use and suitability.—This soil is less desirable than the deeper Cloquallum soils. The growth of deep-rooted plants is somewhat restricted, and the moisture holding capacity is slightly lower. Use and management are the same for Cloquallum silt loam, 5 to 15 percent slopes. Most of the acreage is in a second growth of Douglas-fir. The site class for Douglas-fir is similar to that of the other Cloquallum soils, and it is higher than for most upland soils. Only a small area is in cultivation.

This soil is in capability subclass IVe and in site class 3 for Douglas-fir.

COASTAL BEACH

This land type consists of long, narrow beach-line areas of sand and gravel that have no agricultural value.

Coastal beach, 0 to 2 percent slopes (Cg).—This mapping unit is often washed by extreme high tides or by storm waves, although it is above reach of average tides. It is in capability class VIII.

DECKERVILLE SERIES

The Deckerville series consists of dark-colored, poorly drained soils along waterways and low-lying areas on the glacial plain in the far western part of the county. They have developed from a mixture of glacial and local basaltic and sedimentary materials brought down from the slopes of the southern Olympic Mountains. The rainfall ranges from 70 to 100 inches a year. The vegetation is mainly a dense mixture of sedges, reeds, and water-loving brush.

Deckerville soils have a shallow, highly organic, mineral surface soil overlying a coarse, gravelly subsoil and a substratum similar to that underlying the Sol Duc soils. Deckerville soils differ from the McKenna soils in parent material and in having a darker and more granular surface soil and upper subsoil.

Deckerville gravelly loam, 0 to 2 percent slopes (Dc).—This soil is almost entirely in the vicinity of Decker-

ville in southwestern Mason County. The surface soil is a very dark gray gravelly loam that is granular, friable, and high in organic matter. The gravel varies in size and shape and is highly stained. At depths of 6 to 8 inches, the soil is more gravelly, slightly plastic, and slightly finer in texture. At depths of 14 to 18 inches, the soil grades to a firm, moderately compact, dark grayish-brown clay loam that is gritty, gravelly, and plastic. At depths of 24 to 34 inches, the soil rests abruptly on a deep substratum of fairly compact gravel, cobbles, and coarse sand highly stained with iron and manganese.

In winter and spring, the water table is practically at the surface and the soil is very wet. It dries soon after the water table is lowered and, in long dry spells, may become fairly dry. If the water table is low, this soil absorbs water moderately well. This soil is medium acid throughout the profile.

Use and suitability.—Much of this soil has been cleared and is used for hay, grain, and pasture. These are the only feasible crops because the growing season is short. Drainage of excess surface water is necessary for cultivated crops, and it helps permanent pastures. The soil is used only for pasture if the adjacent, better drained Le Bar and Hoquiam soils are used for hay and grain. Yields depend partly on local drainage and on seasonal rainfall, both of which vary from year to year. The rotation commonly used consists of 2 years of oats and vetch followed by 2 years of mixed timothy, orchard-grass, and clover. In the fourth year of the rotation, the grass and clover mixture is plowed under as green manure.

This soil is in capability subclass IVw; it is fair for mixed forests.

Deckerville silt loam, 0 to 2 percent slopes (Dc).—The 8- to 15-inch surface horizon is nearly free of gravel. The upper 6 to 8 inches of the surface soil consists of granular and friable, very dark gray silt loam. Below depths of 6 to 8 inches, this layer grades to a firm, plastic, dark-gray silty clay loam that is slightly stained and mottled with yellowish and reddish brown and contains scattered gravel highly coated with organic colloids. The silty clay loam grades to a firm, dark grayish-brown gravelly clay loam that extends to depths of 24 to 36 inches. Below this, the material grades abruptly to a firm, highly stained, and clay-coated mass of sand and gravel.

Gravel in the surface soil and the depth to the coarse gravelly substratum vary more in this soil than in Deckerville gravelly loam, 0 to 2 percent slopes. Near the Grays Harbor County line, the upper 24 inches is nearly free of gravel, and the soil is not so dark colored.

Use and suitability.—This soil is more desirable for cultivation than Deckerville gravelly loam, 0 to 2 percent slopes, because it contains less gravel, is more easily tilled, and has a higher available moisture-holding capacity. If moisture and drainage are favorable, yields from this soil are higher. Use and management are similar to those of Deckerville gravelly loam, 0 to 2 percent slopes.

This soil is in capability subclass IVw; it is fair for mixed forests.

Deckerville silty clay loam, 0 to 2 percent slopes (Dd).—This soil differs from the Deckerville silt loam, 0 to

2 percent slopes, mainly in texture of the surface soil. It also differs in that iron and manganese stains and the clay coatings are more definite on the gravel in the subsoil and substratum. The soil also normally lies at a slightly lower position; consequently, it is more swampy.

Use and suitability.—Natural drainage is slower on this soil, but, where it can be artificially drained, the use is similar to that of Deckerville silt loam, 0 to 2 percent slopes.

This soil is in capability subclass IVw; it is fair for mixed forests.

Deckerville gravelly silty clay loam, 0 to 2 percent slopes (Db).—The gravelly surface layer distinguishes this soil from Deckerville silty clay loam, 0 to 2 percent slopes. In other characteristics the two soils are similar.

Use and suitability.—The use and management suggested for Deckerville gravelly loam, 0 to 2 percent slopes, apply to this soil, though this soil has slower drainage.

This soil is in capability subclass IVw; it is fair for mixed forests.

DELPHI SERIES

The Delphi series consists of brown, medium to strongly acid, well-drained, glacial soils of the uplands. They are in the southern part of the county, mainly along the high ridge between Mud Lakes and Skookum Creek, which is near the highest elevation at which glacial activity took place in the area. Most of the glacial material was deposited by the prong of the glacier that extended from Mud Lakes to a gap near Stimson. Although intermittent areas have a substratum of indurated material, most of the underlying parent material is weakly to strongly cemented and consists of reworked glacial till and large amounts of local basic rock.

The Delphi soils are friable and moderately deep; they have a higher available moisture-holding capacity than the Shelton or the Grove soils, which they resemble in many ways. The Delphi soils are closely associated with the Tebo soils.

Delphi gravelly loam, 5 to 15 percent slopes (De).—This soil occupies rolling topography and has some slopes as strong as 20 percent. On its surface there is a 1-inch layer of dark organic matter. The surface soil consists of 8 to 12 inches of friable, brown gravelly loam. This layer is underlain by friable, yellowish-brown gravelly loam upper subsoil that is from 24 to 32 inches thick. Below this and to depths of 48 to 60 inches is the lower subsoil consisting of firm, light yellowish-brown gravelly loam or sandy loam. The substratum is a heterogeneous mixture of weakly to strongly cemented glacial till and weathered local bedrock. Glacial stone, gravel, and fragments of local basalt are in the substratum and, to some extent, in the horizon above. The forest cover is luxuriant and growing rapidly.

The soil is deep and friable and has a good available moisture-holding capacity. Roots and water readily penetrate to the substratum. The surface soil is medium to strongly acid; the substratum is medium acid.

Use and suitability.—This soil is best for forestry because of altitude and inaccessible location. Most of it has been logged and is now covered by young trees, mainly second-growth Douglas-fir. Where natural reseeding of Douglas-fir has been slow, nearly pure stands of alder and maple have taken over. The soil should be

managed for the production of timber. It is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Delphi gravelly loam, 15 to 30 percent slopes (Df).—This soil occupies steeper and more rugged terrain than Delphi gravelly loam, 5 to 15 percent slopes. The dense forest and inaccessibility of the area made the determination of slope boundaries difficult. Consequently, this mapping unit includes areas of Delphi gravelly loam that have slopes of less than 15 percent and of more than 30 percent. The soil differs from Delphi gravelly loam, 5 to 15 percent slopes, in containing varying amounts of basaltic fragments and local material mixed in the glacial till. The content of these materials does not vary enough to alter greatly the soil profile. The soil on the southern side of ridges contains more basalt and local material than that on the northern slopes.

Use and suitability.—If this soil is cleared and farmed, its use is limited more by erosion than that of Delphi gravelly loam, 5 to 15 percent slopes. Otherwise, the suitability of the two is the same.

This soil is in capability subclass VIe and in site classes 3 and 4 for Douglas-fir.

DUNGENESS SERIES

The Dungeness series consists of brown, moderately well drained, alluvial soils. They mainly occupy the flood plains of the Skokomish and Hamma Hamma Rivers and are flooded only when water is very high. They have developed from parent material that originated from various kinds of metamorphosed, basic igneous, and sedimentary rocks. The rainfall ranges from 60 to 90 inches a year. The vegetation is a dense forest of evergreen and deciduous trees.

The Dungeness soils are associated with the Pilchuck, Skokomish, and Puget soils but are more brown throughout the profile. They are in slightly more elevated positions than the Skokomish soils, and their subsoil is less mottled.

Dungeness fine sandy loam, 0 to 2 percent slopes (Dg).—This soil is mainly on the flood plain of the Skokomish River, in fairly large areas where drainage is moderately good. The surface soil is granular and very friable, brown fine sandy loam. The color is uniform to depths of 8 to 10 inches; then, the layer is slightly lighter colored and contains less organic matter. Below depths of 18 to 24 inches, the soil is pale-brown, or in places grayish-brown, slightly friable fine sandy loam and silt loam. It is very slightly compacted and has a few faint mottles of yellow and rust brown. The underlying material extends to depths of 30 to 46 inches; it consists of stratified, grayish-brown fine sand and silt with occasional strata of gravel at lower depths. This material is faintly stained and mottled but free from compaction.

The soil is slightly acid to medium acid throughout the profile. It has a high capacity for holding available moisture. The water table is occasionally high in winter and spring.

Use and suitability.—This soil is extensively used for hay, pasture, and grain. The high water table in winter and spring limits its use for other crops but raspberries are grown successfully.

Under intensive use, organic matter and nitrogen must be maintained through use of barnyard manure and the growing of legumes and green-manure crops.

The soil is flooded in years when water is highest and is badly damaged if it is not protected. Truck crops will produce high yields but may be damaged by floods. Sod should protect the soil in flood periods.

This soil is in capability subclass IIw; it is good for mixed forests.

Dungeness silt loam, 0 to 2 percent slopes (Dk).—This soil occurs with Dungeness fine sandy loam, 0 to 2 percent slopes. The surface soil is a very friable and granular, slightly acid, brown silt loam, 8 to 10 inches thick. It is underlain by a friable, uniformly pale-brown silt loam that reaches to depths of 24 to 30 inches. The pale-brown layer is underlain by a stratified, pale-brown or grayish-brown silt loam and fine sandy loam that continues to depths of 40 to 48 inches. This last-mentioned layer is mottled with rust brown and yellowish brown. The underlying material, commonly at depths below 40 inches, consists of stratified grayish-brown, loose sand, fine sand, silt, and gravel. The substratum in some places is within 28 to 30 inches of the surface.

Surface and internal drainage are adequate, except in periods of prolonged high water and flooding.

Use and suitability.—This highly fertile soil is extensively used for hay and pasture because it is in a dairying area. The use is similar to that of Dungeness fine sandy loam, 0 to 2 percent slopes. Yields are the same or slightly higher. The main risks in using this soil are the possibilities of flood erosion and an occasional high water table in winter and spring.

This soil is in capability subclass IIw; it is good for mixed forests.

Dungeness fine sandy loam, shallow, 0 to 2 percent slopes (Dh).—This soil is adjacent to the other Dungeness soils. The depth of the soil is limited by a substratum of loose sand and gravel that is 18 to 30 inches from the surface. As for the other Dungeness soils, the profile is uniform down to the loose sand and gravel. Included with this soil are areas that have a fine sandy loam or silt loam surface soil.

The shallowness of this soil limits its available moisture-holding capacity and desirability for crops.

Use and suitability.—Crops grow well in years when moisture is adequate. During dry summers, pasture and hay dry up and yields are noticeably reduced. Use and management are otherwise similar to those for Dungeness silt loam and fine sandy loam.

This soil is in capability subclass IIIs. It is good for mixed forests.

EDMONDS SERIES

The Edmonds series consists of grayish-brown, poorly drained, level to gently undulating soils. They have developed from sandy glacial drift. The rainfall ranges from 45 to 70 inches a year. The vegetation is densely growing sedges, reeds, spirea, and wild grape. These soils have a fairly definite iron oxide cementation in the subsoil.

Nearly all of this series is near Belfair in the north eastern part of the county, but there are a few areas elsewhere. Edmonds soils are similar to the Norma soils but have a lighter colored surface soil, contain less organic matter, and have a subsoil in which there is iron oxide cementation (ortstein).

Edmonds fine sandy loam, 0 to 2 percent slopes (Ea).—All of this soil lies along the lower valley of the Union

River. The surface soil is friable, grayish-brown (dark-gray to dark grayish-brown when moist) fine sandy loam, 6 to 10 inches thick. It is mottled with light gray, and it contains intermittent iron cementation, a large amount of fine sand, and a moderate amount of organic matter.

The subsoil is a light-gray sandy loam or fine sandy loam, prominently mottled with reddish brown and yellowish red. It extends to a depth of about 18 to 30 inches. The transition between the surface soil and subsoil is abrupt. Softly cemented, incipient iron hardpan (ortstein) occurs irregularly throughout the subsoil.

The substratum is friable, light-gray fine sandy loam or loamy sand mottled with yellowish brown and reddish yellow. It is stratified with lenses of silt, but near Puget Sound, it is stratified with lenses of peat. The substratum is mottled less than the subsoil, and iron oxide accumulations are lacking. The most prominent mottles in the lower part of the profile are the result of reduced aeration.

All layers are medium to strongly acid. During most of the year, the water table is within a foot of the surface.

Use and suitability.—This soil must be drained before it can be farmed profitably. Open ditches are suitable if drainageways are readily accessible. This soil can be used in about the same way as the Norma soils, and a very small acreage is in use mainly for pasture and hay. This soil contains less organic matter, has a coarser texture, and is less fertile and productive than the Norma soils.

Uncleared areas are covered by a dense growth of deciduous trees, brush, shrubs, and scattered cedar. Partly cleared areas provide but little grazing, unless the better forage grasses are maintained, and they are quickly overgrown by sedges, reeds, spirea, and wild rose.

This soil is in capability subclass IIIw; it is good for mixed forests.

Edmonds silt loam, 0 to 2 percent slopes (Eb).—This soil differs from Edmonds fine sandy loam, 0 to 2 percent slopes, in texture, in containing more organic matter, and in having a better capacity for holding available moisture. The soil is strongly acid.

Use and suitability.—Only a small acreage is used for farming, mainly for pasture, hay, and grain. Barnyard manure and green manure are used to maintain nitrogen and organic matter. The use of a complete fertilizer and lime is beneficial. In most respects, management is similar to that of the Norma soils.

This soil is in capability subclass IIIw; it is good for red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

ELD SERIES

The Eld series consists of reddish-brown, moderately well drained soils. They are on low terraces on the fairly broad valley floors. They are above flood stage, so they are inundated only in years of very high water. They are developing from stream alluvium derived mainly from basaltic and sedimentary rocks mixed with some glacial material. The rainfall is 60 to 70 inches a year. The vegetation is dense coniferous forest. Where the soils are flooded, they vary in color and degree of mottling within short distances.

The Eld soil occurs only in the extreme southern end of the county. It differs from the Maytown soils in having a redder surface soil and subsoil, some faintly developed shot, and stronger red and yellow staining of the subsoil.

Eld silt loam, 0 to 3 percent slopes (Ec).—This soil is at the head of Oyster Bay. The surface soil is reddish-brown, granular and friable silt loam, 6 to 10 inches thick, that contains a few very soft shot. This layer is underlain by a reddish-brown, firm clay loam that has a subangular blocky structure, is highly stained by iron, and contains considerable amounts of shot. At depths ranging from 20 to 32 inches, the clay loam rests on a layer of fairly compact, stratified sand and gravel that is prominently stained by iron. Rounded glacial gravel, mixed with subangular basaltic gravel, is scattered on the surface and through the soil.

The soil is medium acid throughout. Surface drainage is moderately well established, though small swales may stay wet for a long time. Subsurface drainage is fairly slow because of a slowly receding, fairly high water table.

Use and suitability. Most of the soil is used for pasture or grain. Management is similar to that of Maytown silt loam, 0 to 3 percent slopes, but yields are slightly lower.

This soil is in capability subclass IIIIs; it is good for fir, redcedar, hemlock, and deciduous trees.

EVERETT SERIES

The Everett series consists of somewhat excessively drained, pale-brown gravelly soils. They occur as inextensive gravel ridges on the glacial moraines, or, more commonly, as fairly continuous outwash channels between ridges of Alderwood soils. They have developed upon assorted glacial till and outwash material. The rainfall is 45 to 60 inches a year. The vegetation is mainly drought-resistant madrone, manzanita, and kinikinnick.

Everett soils are droughty because the loose gravel and sandy subsoil and substratum offer little resistance to downward movement of water. The capacity of the surface soil to hold available moisture is low.

Everett soils are in the eastern half of the county, in association with the Alderwood soils. They also occur in intricate patterns with the Kitsap and Indianola soils. Compared to the Grove soils, the Everett soils have a paler surface soil and subsoil and, in development, were dominated more by acid igneous parent rock.

Everett gravelly sandy loam, 5 to 15 percent slopes (Eg).—This is the most extensive Everett soil. In undisturbed forests 1 to 2 inches of very dark grayish-brown material, a mixture of needles, leaves, twigs, cones, moss, and roots, covers the surface. The surface soil is loose, single-grained, pale-brown, gravelly sandy loam, 6 to 8 inches thick. The upper 2 or 3 inches normally contains aggregates that are slightly hard and redder than the others in the layer. To depths ranging from 18 to 24 inches, the subsoil is loose, single-grained, light yellowish-brown gravelly sandy loam or gravelly loamy sand. The amount of shot decreases with depth; in the lower part only a few shot occur.

The subsoil grades to a substratum of poorly assorted, predominantly yellowish-brown sand, gravel, and cobbly

material that is extremely loose and porous. However, in places, this material will stand in banks. The color of this material is largely determined by the gravel, coarse sand, and cobbles, which are olive gray, pale olive, yellowish brown, light brownish gray, gray, and dark gray. Many of the cobbles, as well as much of the gravel, are faintly to moderately stained by iron.

The amount of gravel ranges from about 20 percent to 50 percent in the subsoil to as much as 80 percent in the substratum. The soil is medium to strongly acid and becomes less acid with depth.

Use and suitability.—This soil is too droughty for most tilled crops—it dries out before crops mature. Only a very small acreage is cultivated, and this is ordinarily farmed along with better adjacent soils. Most of this soil is in brush and trees, for which it is suited best. It is one of the better soils for growing Douglas-firs that are cut for Christmas trees. This is an important use of the soil; large acreages are used for Christmas trees.

This soil is in capability subclass VIIs and in site class 4 for Douglas-fir.

Everett gravelly sandy loam, 0 to 5 percent slopes (Eg).—This soil occupies the smoother outwash terraces in association with other Everett soils. It differs from Everett gravelly sandy loam, 5 to 15 percent slopes, in that its surface layer is generally 2 to 3 inches thicker; the profile is less variable; and the substratum, or underlying material, is usually more stratified.

Use and suitability.—The use of this soil is similar to that of Everett gravelly sandy loam, 5 to 15 percent slopes. The soil is in trees and brush, except for a few small cleared areas. The growing of Douglas-fir for Christmas trees is gaining in importance. This soil is in site class 4 for Douglas-fir and in capability subclass VIIs.

Everett gravelly sandy loam, 15 to 30 percent slopes (Ek).—This soil is on the steeper slopes of glacial moraines, sides of gullies, and terrace fronts. It is closely associated with other Everett soils and the Alderwood gravelly sandy loams.

This soil is more variable than Everett gravelly sandy loam, 5 to 15 percent slopes. The depth to substratum ranges from 12 to 36 inches, and the amount of gravel in the surface soil and subsoil varies greatly from place to place. Where the soil is in close association with the Alderwood soils, the substratum, in places, is compact and weakly cemented.

Included are a few areas having slopes slightly greater than 30 percent.

Use and suitability.—This soil is suitable only for forestry because it is strongly sloping, droughty, and low in fertility. It is in capability subclass VIIs and in site class 5 for Douglas-fir.

Everett gravelly loamy sand, 0 to 5 percent slopes (Ed).—This soil occupies the smoother terraces or outwash plains in close association with other Everett soils. It differs from Everett gravelly sandy loam, 5 to 15 percent slopes, in having a finer surface soil and a slightly coarser subsoil.

Use and suitability.—Use and management are similar to those for Everett gravelly sandy loam, 5 to 15 percent slopes. This soil is poorer for forest than Everett gravelly sandy loam, 0 to 5 percent slopes. It is in capability subclass VIIs and in site class 5 for Douglas-fir.

Everett gravelly loamy sand, 5 to 15 percent slopes (Ee).—This soil is similar to Everett gravelly loamy sand, 0 to 5 percent slopes, but its profile is more variable and the thicknesses of the surface soil and subsoil are slightly less.

Use and suitability.—Practically all of this soil is in trees and brush. Its best use is for Christmas trees. This soil is in capability subclass VIIs and in site class 5 for Douglas-fir.

Everett gravelly loamy sand, 15 to 30 percent slopes (Ef).—Except for slopes, this soil is similar to Everett gravelly loamy sand, 5 to 15 percent slopes. Profile characteristics vary greatly from place to place, especially on the steeper slopes.

Use and suitability.—All of this soil is in trees and brush, and its best use is forestry. It is in site class 5 for Douglas-fir and in capability subclass VIIs.

GRAVEL PIT

This miscellaneous land type consists of open pits from which the soil and underlying material have been excavated. The pits are about 1 to 5 acres in size and are shown on the soil map by the letter symbol Ga. Pits smaller than 1 acre are shown on the map by conventional symbols. Most gravel pits are in soils of the Everett, Grove, and Carstairs series. The excavated gravelly material has been used mainly for road construction.

GROVE SERIES

The Grove series consists of somewhat excessively drained, reddish-brown gravelly soils. It occupies the large glacial outwash plains. The Grove soils have developed from Vashon glacial drift, modified considerably by inclusions of local basaltic rock and mixed material from the Olympic Mountain glaciers. The rainfall ranges from 60 to 100 inches a year. The vegetation is coniferous forest, with an understory dominated by the lower growing mosses, kinnikinnick, and snowberry, and these mixed with huckleberry, salal, and Oregon-grape. The drought-resistant manzanita is especially common on the Grove soils. The cover is not so profuse nor so rank as that on the adjacent Shelton and Hoodsport soils. Logged areas restock slowly to Douglas-fir, and some pure stands of lodgepole pine are on these soils.

The Grove soils occur in the western part of the county, in association with the Shelton and Hoodsport soils. Grove soils differ from the Everett soils farther east in their parent material and in having redder surface soil and subsoil.

Grove gravelly sandy loam, 0 to 5 percent slopes (Gn).—This soil occupies nearly level outwash plains.

In forested areas there is a 1- to 2-inch layer of needles, leaves, twigs, roots, and moss. The lower part is moderately decomposed and very dark grayish brown.

The surface soil consists of reddish-brown, gravelly sandy loam, 6 inches thick. It is very friable, is single grained, and contains a few small, round shot. The upper part of this layer contains a few firm, irregular, more reddish aggregates. The next layer extends to depths ranging from 12 to 14 inches. It is similar to the surface soil, except that it is more gravelly, contains less shot, and the gravel is stained and coated with dark reddish-brown fine material.

The subsoil is a light-brown, very gravelly loamy sand. It is loose, is single grained, and contains no shot. At depths ranging from 24 to 32 inches, the subsoil grades to the substratum of loose gravel, cobbles, and sand. The dominant colors are gray, grayish brown, yellowish brown, and light brown. Much of the gravel is highly stained with nearly black and reddish brown material. In places the upper 24 inches of the substratum is compact or weakly cemented.

Included with this soil are about 250 acres occurring on gently sloping fans, colluvial slopes, and terraces. The parent material of the included soils is a mixture of local basic igneous rock and mixed glacial material. The profile is similar to that of Grove gravelly sandy loam, 0 to 5 percent slopes, but it differs in being brown and yellowish brown, more variable in texture and in degree of stratification, and in containing much angular and subangular gravel.

This soil is strongly to medium acid and less acid with depth. Surface runoff is very slow because of the rapid permeability of the soil and the smooth topography.

Use and suitability.—Except for a very small acreage in farms producing mainly for the farm household, this soil is in forest, a use for which it is best suited. Because of droughtiness and low fertility, it is not suitable for hay or pasture. In suitability, this soil is similar to the Everett gravelly sandy loam, 0 to 5 percent slopes, except that it is in classes 3 and 4 for Douglas-fir, partly because of the higher rainfall. Areas in young Douglas-fir are managed for Christmas trees. The soil is in capability subclass VIIs.

Grove gravelly sandy loam, 5 to 15 percent slopes (Gk).—In places the surface soil and subsoil of this soil are 3 to 6 inches thinner than those of Grove gravelly sandy loam, 0 to 5 percent slopes.

Use and suitability.—The use of this soil is similar to that of Grove gravelly sandy loam, 0 to 5 percent slopes. Like that soil, it is best suited to forestry. The soil is in capability subclass VIIs; it is in site classes 4 and 5 for Douglas-fir.

Grove gravelly sandy loam, 15 to 30 percent slopes (Gm).—This soil occupies the slopes bordering on terrace fronts.

The profile is similar to that of Grove gravelly sandy loam, 0 to 5 percent slopes, except that depths to the gravel and sand of the substratum range from 18 to 40 inches. The amount of gravel in the profile also varies greatly from place to place. Surface runoff is more rapid than from Grove soils having slopes of less than 15 percent.

Use and suitability.—This soil is suitable only for forest because of its slopes, droughtiness, and low fertility. This soil is in capability subclass VIIs and in site class 4 for Douglas-fir.

Grove gravelly sandy loam, 30 to 45 percent slopes (Gn).—Most of this soil occurs on short, steep slopes and in rough areas bordering valleys or terrace fronts. It differs from Grove gravelly sandy loam, 15 to 30 percent slopes, in slopes and topography. In addition, the depths to the substratum change in short distances from less than 12 inches to as much as 36 inches. The surface soil and subsoil normally contain 50 percent or more of gravel.

Use and suitability.—All of this soil is in forest. It should be left in its natural cover because of droughtiness and rough topography. This soil is in capability subclass VIe and in site class 4 for Douglas-fir.

Grove cobbly sandy loam, 0 to 5 percent slopes (G_o).—This soil has more cobblestones than Grove gravelly sandy loam, 0 to 5 percent slopes. From 20 to 50 percent of the surface soil and subsoil is cobblestones.

Use and suitability.—This soil is not suitable for cultivation. Its best use is for forestry. It is in capability subclass VIIs and in site class 4 for Douglas-fir.

Grove cobbly sandy loam, 5 to 15 percent slopes (G_c).—This soil resembles Grove gravelly sandy loam, 0 to 5 percent slopes, but contains more cobbles and has stronger slopes.

Use and suitability.—This soil is suited only to forestry. Like other Grove soils, it is droughty and of low fertility. It is in capability subclass VIIs and in site class 4 for Douglas-fir.

Grove cobbly sandy loam, 15 to 30 percent slopes (G_o).—This soil contains more cobblestones than Grove gravelly sandy loam, 0 to 5 percent slopes. From 20 to 50 percent of the surface soil and subsoil is cobblestones.

Use and suitability.—This soil is best suited to forestry because of the cobblestones and its droughtiness and low fertility. It is in capability subclass VIIs and in site class 4 for Douglas-fir.

Grove stony sandy loam, 0 to 5 percent slopes (G_p).—This soil occurs in a few scattered areas in association with Grove cobbly sandy loams and Grove gravelly sandy loams. Compared with the gravelly sandy loams, it has more stones, 10 inches or more in diameter, scattered over the surface and throughout the profile. The stones interfere with cultivation.

Use and suitability.—Because of stones, droughtiness, and low fertility, this soil is suited only to forestry. It is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Grove gravelly loam, 0 to 5 percent slopes (G_e).—This soil occurs in association with Grove gravelly sandy loam, 0 to 5 percent slopes, but it is in slightly lower positions. It differs from that soil only in texture of the upper 6 or 8 inches of surface soil. The subsoil ranges from a gravelly sandy loam to a gravelly loamy sand.

This soil is not so droughty as Grove gravelly sandy loam, 0 to 5 percent slopes, although it is somewhat excessively drained and has a low capacity to hold available moisture.

Use and suitability.—This soil is marginal for agriculture. It is used about the same as Grove gravelly sandy loam, 0 to 5 percent slopes, but yields of hay, pasture, and small grains are slightly higher. The best use is forestry.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Grove gravelly loam, 5 to 15 percent slopes (G_f).—This soil occupies rolling slopes in close association with Grove gravelly loam, 0 to 5 percent slopes. It differs from that soil only in slopes.

Use and suitability.—This soil is suitable for the same uses as Grove gravelly loam, 0 to 5 percent slopes. It is

in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Grove gravelly loam, basin phase, 0 to 5 percent slopes (G_g).—This soil occurs in small basinlike areas in association with other more droughty Grove soils. It differs from Grove gravelly sandy loam, 0 to 5 percent slopes, mainly in having a brown, instead of a reddish-brown, surface soil that reaches a depth of about 20 inches. When the surface soil is moist, it is slightly darker. The gravel in the subsoil and substratum of this soil is more heavily stained and coated than that in Grove gravelly sandy loam, 0 to 5 percent slopes.

There is little or no runoff, but additional water is received from slightly higher adjacent areas. Water stands on the surface for short periods during the rainy season. The soil is too porous for this additional moisture to have much effect on the profile.

Use and suitability.—Most of this soil is in brush and trees. The best use is forestry. If the soil is used for crops, yields are better than on similar Grove soils, because more moisture is available. This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Grove gravelly sandy loam, basin phase, 0 to 5 percent slopes (G_o).—This soil differs from Grove gravelly loam, basin phase, 0 to 5 percent slopes, in texture of the surface soil.

Use and suitability.—The use of this soil is similar to that of Grove gravelly loam, basin phase, 0 to 5 percent slopes. Yields are lower because the soil has a coarser texture and is slightly more droughty. This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

HARSTINE SERIES

The Harstine series consists of well drained, brown soils of the uplands. They have developed from softly cemented, sandy glacial till that is high in particles of quartzite and granite. The till is similar to that underlying the Alderwood soils, but the upper few feet are sandy and only weakly cemented. The rainfall is the lowest in the county, or from 45 to 55 inches a year. Douglas-fir does not grow well, because the soil is too droughty for trees. The understory is a fairly dense growth of huckleberry. Scattered manzanita and madrone grow in logged areas.

The Harstine soils occur only on the islands of Case Inlet and are primarily on Hartstene Island. The profile of Harstine soils is fairly similar to that of the Alderwood soils, but it is less bright in color: contains more silt and less gravel; and, commonly, has a more pronounced ashy gray, leached layer immediately below the organic litter. The Harstine soils contain more gravel than the Indianola soils and have harder, or more compact, underlying till.

Harstine gravelly sandy loam, 5 to 15 percent slopes (H_c).—This soil occupies gently rolling glacial moraines and is the dominant soil on Hartstene Island. The slopes are as much as 15 percent, but normally they range from 7 to 10 percent.

The surface layer consists of 1 to 1½ inches of organic matter. In undisturbed areas this organic matter is commonly underlain by an ashy, very light gray, leached sandy loam that ranges up to a quarter of an inch thick.

In disturbed areas, this leached sandy loam layer does not exist, but the upper 4 or 5 inches of mineral soil is a weakly granular and friable, brown gravelly sandy loam that contains many shot and is medium acid. This surface soil is underlain by a pale-brown to brown gravelly sandy loam that reaches to depths of 12 to 16 inches. This layer contains less shot than the surface soil, but it is otherwise similar. Below depths of 12 to 16 inches, the subsoil grades to pale-brown, very friable, gravelly sandy loam to gravelly loamy sand. At depths of 24 to 32 inches, there is an abrupt change to weakly cemented till. Faint stains are visible just above the till. The upper 2 to 6 feet, or occasionally more, of underlying till is weakly cemented and very sandy. It is firm in place but loose when broken. This firm till rests upon more compact till that is similar to that underlying the Alderwood soils.

The soil has a fair capacity to hold available moisture. However, it is droughty and low in fertility. Only rarely is there a root mat on the surface of the till as there is on the Alderwood soils.

Use and suitability.—Nearly all this soil has been logged and is in second-growth forest, mainly Douglas-fir. Many areas are only partly restocked; they have a good, but not dense, cover of madrone, stinky laurel, manzanita, and kinnikinnick. Salal and huckleberry grow on timbered areas. Young trees grow fairly well and usually make good Christmas trees. The old Douglas-fir trees were poor and are growing slowly.

Only a small acreage of this soil is in farms, and it is generally used along with less droughty soils. Crops are damaged in dry seasons, but low fertility also accounts for poor yields. Organic matter and nitrogen are limited and must be added if the soil is cultivated. Yields of grapes and loganberries are fairly good, but those of hay, grains, and pasture are poor. The management for grapes and berries on this soil is similar to that on the Sinclair shotty loams, but yields are usually less.

This soil is in capability subclass VIIs. It is in site classes 4 and 5 for Douglas-fir.

Harstine gravelly sandy loam, 15 to 30 percent slopes (Hb).—This soil is on the stronger slopes between the high moraines of Harstine gravelly sandy loam, 5 to 15 percent slopes, and Puget Sound. It is similar to the soil on the moraines but varies more in depth and in degree of compaction of the till.

Use and suitability.—Because of strong slopes, none of this soil is in farms. Forests are similar to those on Harstine gravelly sandy loam, 5 to 15 percent slopes. The growth of Douglas-fir on sheltered slopes is better. It is best to use this soil for Christmas trees.

This soil is in capability subclass VIIs and in site classes 4 and 5 for Douglas-fir.

HOODSPORT SERIES

The Hoodsport series consists of well-drained, reddish soils on the uplands. They have developed from granitic till that is highly stained by iron and that contains considerable metamorphosed and basic igneous gravel and stone. This parent material originated from local glacial till and from glacial till of the Vashon glacier. The rainfall is 70 to 100 inches a year; the vegetation is a dense forest of Douglas-fir and hemlock.

The Hoodsport soils are shallower, stonier, and more acid than the Alderwood soils. In addition, they developed under heavier rainfall.

Hoodsport gravelly sandy loam, 5 to 15 percent slopes (Hd).—This soil is on the high till plain between the Hood Canal and the Olympic Mountains. In many large areas, slopes do not exceed 10 percent, though the total range in slope is from 5 to 15 percent. A 1 inch layer of strongly acid, very dark brown organic matter is on the surface. Under this is the surface soil, a friable, reddish-yellow gravelly sandy loam, 4 to 5 inches thick. The surface soil has a soft, crumb structure and contains many small roots and very few shot. To depths of 16 to 18 inches there is a granular and very friable, very gravelly and gritty sandy loam that contains few shot. The gravel, most of it pea size, accounts for more than half the soil mass.

Below 16 to 18 inches there is a friable, single-grained brownish-yellow gravelly sandy loam. At a depth ranging from 22 to 28 inches, this material rests abruptly on 3 to 10 inches of platy, very hard, light-gray till that is stained with yellow. Below the laminated zone, and to depths of many feet, the till is a light-gray, strongly cemented mixture of gravel, sand, and cobbles.

Many large, irregular areas of the till are highly stained with yellow and reddish brown. Scattered over the surface, throughout the soil, and intermixed with the granitic till are many basic igneous and metamorphosed subangular stones and pebbles.

The soil is shallow, gravelly, and strongly acid. It contains very little clay, and it is low in plant nutrients and in capacity to hold available moisture.

Use and suitability.—Nearly all the soil has been logged and is slowly restocking with the original kinds of forest trees. Douglas fir is the dominant tree. There are many nearly pure stands of lodgepole pine. Hemlock and white pine often occur in scattered stands. The forests are dense, but they are growing slowly and are of poor quality.

The understory is rhododendron, kinnikinnick, an occasional manzanita, and scattered vine maple and stinky laurel—all of which characteristically grow on droughty soil. Huckleberry is common but not luxuriant.

The soil is not suitable for farming; its best use is forestry. It is in capability subclass VIIs and in site classes 4 and 5 for Douglas-fir.

Hoodsport gravelly sandy loam, 0 to 5 percent slopes (Hc).—This soil occurs near Rose Lake. It is close to steep ravines or gullies having slopes greater than 30 percent. This soil differs from Hoodsport gravelly sandy loam, 5 to 15 percent slopes, in having about 10 to 20 percent more gravel in the profile and fewer stones on the surface and in the soil.

Use and suitability.—The statements made for Hoodsport gravelly sandy loam, 5 to 15 percent slopes, apply to this soil, which is in capability subclass VIIs and in forest site classes 4 and 5 for Douglas-fir.

Hoodsport gravelly sandy loam, 15 to 30 percent slopes (He).—This soil is on rougher terrain than Hoodsport gravelly sandy loam, 5 to 15 percent slopes, and, therefore, is considered less desirable. The lower north slopes and some canyons obtain additional moisture through seepage in spring. This moisture is not suf-

fficient to alter the soil, but it somewhat improves the growth of timber.

Use and suitability.—The statements made for Hoodsport gravelly sandy loam, 5 to 15 percent slopes, apply to this soil, which is in capability subclass VI_s and in site classes 4 and 5 for Douglas-fir.

Hoodsport gravelly sandy loam, 30 to 45 percent slopes (Hf).—This soil occupies the deep and precipitous canyons between the plateau and the deeply entrenched Skokomish and Hamma Hamma Rivers and the Hood Canal. Soil develops slowly on these steep slopes. It resembles the more gently sloping Hoodsport soils but has been altered by slips, slides, and soil creep. The profile ordinarily is stony, gravelly, shallow, and droughty.

Use and suitability.—Trees and other vegetation have difficulty surviving, but the cover is sufficient to prevent runoff and hold erosion to a minimum. Old forests of Douglas-fir contain merchantable timber, though not in appreciable quantities. Forests and underbrush are fairly dense but less luxuriant than on surrounding slopes. They are least dense on steep, south facing slopes.

This soil is in capability subclass VI_e. It is in site classes 5 and 6 for Douglas-fir.

Hoodsport stony sandy loam, 5 to 15 percent slopes (Hg).—This soil differs from Hoodsport gravelly sandy loam, 5 to 15 percent slopes, in having many large, irregular stones and boulders scattered over the surface and in the soil and parent material. This lessens the desirability of this soil for any use.

Use and suitability.—The statements made for Hoodsport gravelly sandy loam, 5 to 15 percent slopes, apply to this soil, which is in capability subclass VI_s and in site classes 4 and 5 for Douglas-fir.

Hoodsport stony sandy loam, 15 to 30 percent slopes (Hh).—Except for the stones that are scattered throughout the profile and on the surface, this soil is similar to Hoodsport gravelly sandy loam, 15 to 30 percent slopes.

Use and suitability.—Like Hoodsport gravelly sandy loam, 5 to 15 percent slopes, this soil is best suited to forestry. The stones would interfere with cultivation. This soil is in capability subclass VI_s and in site class 4 for Douglas-fir.

HOQUIAM SERIES

The Hoquiam series consists of well-drained, reddish-brown soils on the uplands. They have developed in a parent material derived from an assortment of sandstone, shale, basalt, and metamorphic rocks. This parent material is a till-like, stained, and highly weathered clay and gravel. Probably this material came from early, local piedmont glaciers in the Olympic Mountains. The parent material, however, may have been deposited by a very early continental glacier.

The Hoquiam soils have developed in an annual rainfall of 70 to 95 inches and under a very dense forest consisting of Douglas-fir, hemlock, cedar, and an occasional spruce. Logged areas have restocked to Douglas-fir and cedar or to alder and maple. Semicleared areas are quickly overgrown by bracken fern and brush.

The Hoquiam soils are in the extreme western and southwestern parts of the county, where they occupy the gently rolling to hilly topography.

Hoquiam silt loam, 5 to 15 percent slopes (Hp).—This is the dominant soil in the Hoquiam series. On the

surface is a layer of partly decomposed organic matter, 1 to 2 inches thick. The upper 3 to 5 inches of mineral soil is friable, granular, medium acid, reddish-brown silt loam (dark reddish brown when moist). This material contains shot and roots. It is underlain by 10 to 12 inches of reddish brown, friable silt loam having a subangular blocky structure and a fairly high content of shot. At depths of 12 to 16 inches there is a firm, yellowish-red, slightly finer textured silt loam subsoil that has strong, subangular blocky structure. The soft clods break easily and can be rubbed to a smooth mass, but there will be a great many small, gritty shot. At depths of 30 to 36 inches, the lower subsoil begins. It is a firm, reddish-yellow, light clay loam. At depths of 48 to 60 inches, the lower subsoil rests upon a compact till-like matrix of clay and highly weathered, softened gravel. This gravel is of mixed origin but is predominantly from basic igneous and sedimentary parent rock. The matrix is strongly acid, highly colored with red, gray, and yellow, and from 2 feet to several feet thick. It is firm, resists penetration of water and roots, and is underlain by a similar but nonfriable weathered matrix or by soft sandstone and shale.

Small quantities of rounded and subangular gravel are scattered throughout the profile in places. After periods of heavy rain, the horizon just above the till-like matrix remains saturated with water for some time. The soil is strongly leached, medium to strongly acid, and low in plant nutrients.

Use and suitability.—Nearly all this soil is uncleared and is used for forestry and grazing. The thick cover of trees and brush limits grazing, but, if the overstory is partly cleared, excellent grazing can be obtained. This is one of the best forest soils in the county. The original forest was largely Douglas-fir and cedar, and it contained excellent timber. The principal forestry problem is the utilization of large areas of deciduous trees that restock the soil before Douglas-fir can establish itself again. Special management is worthwhile because good timber can be grown.

This soil is more desirable for agriculture than the surrounding gravelly, droughty, and hilly soils. It is used intensively when it occurs on farms. Its use for agriculture is limited, however, by excessive rainfall, high cost of clearing, low fertility, and location in sparsely settled parts of the county.

Probably less than 300 acres of this soil is in farms. It is used mainly for grains, pasture, and hay—crops needed in dairying and raising of beef cattle. The soil is in capability subclass VI_s. It is in site classes 1 and 2 for Douglas-fir.

The soil needs nitrogen and will also respond to phosphate. However, other than barnyard manure, the soil gets only occasional applications of these fertilizers. Commercial fertilizer, barnyard manure, and leguminous cover crops should be used more frequently on this soil.

Hoquiam silt loam, 0 to 5 percent slopes (Ho).—This soil occurs on areas that are slightly elevated from the surrounding glacial outwash plain. It is associated with the Grove and Sol Duc soils but differs from them in being nearly free of gravel.

Use and suitability.—This soil is somewhat more desirable for cultivation than Hoquiam silt loam, 5 to 15 percent slopes, because it is nearly level. Management of

the two soils is similar. This soil is in capability subclass VI_s and in site classes 1 and 2 for Douglas-fir.

Hoquiam silt loam, 15 to 30 percent slopes (Hr).—This soil differs from Hoquiam silt loam, 5 to 15 percent slopes, only in relief. Occasional slopes having gradients of more than 30 percent are included, though the dominant range in slopes is from 15 to 30 percent.

Use and suitability.—Because of steep slopes, this soil is suited to forestry and grazing. The dense growth of trees, brush, and shrubs restricts the grazing. Maple and alder interfere with the restocking of Douglas-fir in some areas. The soil is in capability subclass VI_e. It is in site classes 1 and 2 for Douglas-fir.

Hoquiam gravelly silt loam, 5 to 15 percent slopes (Hk).—This soil contains much more gravel than the Hoquiam silt loams and is shallower to the substratum. The gravel is mainly from basic igneous and sedimentary rock, but gravel of the Vashon glacier is included where this soil lies close to the Shelton and Grove soils. The last continental glacier did not leave a distinct moraine, so there is mixing of the different types of materials in tracts occupied by Hoquiam, Shelton, and Grove soils.

The surface soil consists of granular, friable, reddish-brown gravelly silt loam, 12 to 15 inches thick. In undisturbed areas, under the organic litter, the top 2 to 5 inches of this mineral soil is darker colored and higher in organic matter. Below depths of 12 to 15 inches there is friable, yellowish-red gravelly silt loam. This silt loam becomes firm at a depth of about 38 inches, and at depths of 38 to 48 inches it gives way abruptly to a substratum of highly weathered clay.

Included with this soil is an area of about 230 acres southeast of Carstairs Prairie where the soil is darker colored because of the influence of Astoria soil material. This area is transitional between Astoria and Hoquiam soils.

Use and suitability.—The use and management for this soil are the same as for Hoquiam silt loam, 5 to 15 percent slopes. This soil is in capability subclass VI_s and in forest site classes 1 and 2 for Douglas-fir.

Hoquiam gravelly silt loam, 15 to 30 percent slopes (Hm).—This soil is closely associated with Hoquiam gravelly silt loam, 5 to 15 percent slopes, but there is greater variation in the amount of gravel it contains. The depth to substratum ranges from 30 inches at the top parts of slopes to more than 48 inches on the lower parts of slopes.

Use and suitability.—This soil is more susceptible to erosion than Hoquiam gravelly silt loam, 5 to 15 percent slopes. Forestry is the best use of this soil; all of it is in second-growth forest. It is in capability subclass VI_e and in site classes 1 and 2 for Douglas-fir.

Hoquiam loam, 15 to 30 percent slopes (Hn).—This soil occupies hilly areas near the Grays Harbor County line. It differs from other Hoquiam soils in that it contains very little gravel, and the matrix consists mostly of highly weathered, sandy, glacial deposits. On the higher ridges, gravel is commonly scattered over the surface, and pockets of it may occur in the matrix.

In undisturbed areas, there is 1 to 2 inches of organic litter on the surface. Under the litter is friable, granular, dark reddish-brown loam that contains moderate amounts of shot. At depths of 4 to 6 inches, this loam grades to a horizon that contains less organic matter and is more firm. At depths of 10 to 12 inches, this firmer

material grades to a yellowish-red loam that contains more clay and coarse grit. The loam is firm in place, but not compact; it has a weak, subangular blocky structure and contains relatively few shot. Beginning at depths of 18 to 22 inches, there is a brownish-yellow, gritty clay loam in which the particles of sand are highly weathered and soft. The gritty clay loam is firm but not compact; it has a weak, subangular blocky structure and contains soft, reddish concretions but no shot. The soil profile becomes more yellow with depth. At depths of 4 to 5 feet, the soil is underlain by a matrix of variegated gray, yellow, and reddish-yellow, highly stained and weathered, bedded sands.

Use and suitability.—All the soil has been logged and now is in second-growth forest or in various stages of restocking. Trees grow well on this soil, and, where it is adequately restocked, excellent yields of forest products can be obtained. Forestry is the best use of this soil because it is hilly. This soil is in capability subclass VI_e and in site classes 1 and 2 for Douglas-fir.

Hoquiam and Astoria silt loams, 5 to 15 percent slopes (Hs).—This mapping unit occurs between areas of Hoquiam and Astoria soils, where the Hoquiam and Astoria soils are so intermixed they could not be mapped separately. Soil profiles resembling both of these soils occur in no definite pattern. In places the profiles have some characteristics of both soils.

Use and suitability.—All areas are forested. Management is similar to that of Astoria silt loam, 5 to 15 percent slopes. The mapping unit is in capability sublass VI_s and site classes 1 and 2 for Douglas-fir.

Hoquiam and Astoria silt loams, 15 to 30 percent slopes (Ht).—Except for stronger slopes this mapping unit is like Hoquiam and Astoria silt loams, 5 to 15 percent slopes.

Use and suitability.—Use and management are the same as described for Astoria silt loam, 15 to 30 percent slopes. This mapping unit is in capability sublass VI_e and in site classes 1 and 2 for Douglas-fir.

INDIANOLA SERIES

In the Indianola series are excessively drained, droughty, brown soils of the uplands. They have developed on hummocky and rolling ridges from glacial drift that consisted of loose, porous sand. The sand came mainly from acid igneous rocks. The annual rainfall ranges from 50 to 70 inches, and the native vegetation is mainly Douglas-fir.

Indianola soils occur in the eastern half of the county in association with the Alderwood and the Everett soils. They are unlike the Everett soils in that they are not gravelly. They differ from the Alderwood soils in not being gravelly and in having a sandy, rather than a cemented, substratum. Indianola soils are more nearly like the Lystair soils in the western part of the county. They differ from those soils mainly in having brown and yellowish-brown colors and less basic igneous material in the parent drift. The Lystair soils are brown and reddish yellow, and they occur in an area of higher rainfall.

Indianola loamy sand, 5 to 15 percent slopes (lb).—This is the dominant soil of the Indianola series. It is associated with other Indianola soils and the Everett and Alderwood soils.

Forested areas have a 1- to 2-inch surface layer of organic litter consisting of partly decomposed needles, leaves, twigs, roots, and moss. The surface soil, to a depth of 5 inches, is brown, very friable, single-grain loamy sand that contains a few rounded shot and many roots. The upper 2 or 3 inches of surface soil contains intermittent, firm or slightly hard, irregular aggregates stained with iron. The surface soil is dark brown when moist. The next 10 inches of soil, a transitional layer, is slightly lighter in color than the surface layer and contains fewer shot.

The subsoil, a pale-brown loamy sand, begins at 15 inches and continues to depths of 26 to 30 inches. It is dark yellowish brown when moist. This loamy sand is massive but readily crushes to loose, single grains. Yellow and olive-colored sands are common. The subsoil gradually changes to the substratum, which is gray and dark-gray sand. The substratum is massive but crumbles readily to single grains when removed. It contains some light-gray, yellow, and yellowish-brown sand.

A few pebbles are scattered throughout the profile where this soil merges with the Everett or Alderwood soils. The reaction is medium to strongly acid and is less acid with depth.

Use and suitability.—Most areas are covered by second- or third-growth Douglas fir and hemlock, heavily mixed with alder, willow, and other deciduous trees and shrubs. This soil is so droughty and low in fertility that, except for hay and pasture, its use for agriculture is limited. The best use is forestry. In some areas where supplies of moisture are more favorable, raspberries and strawberries grow fairly well if fertilized.

This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Indianola loamy sand, 0 to 5 percent slopes (Ic).—This inextensive soil is similar to Indianola loamy sand, 5 to 15 percent slopes. Normally, the supply of moisture that plants can use is slightly greater because runoff is less. In many places this soil is at the base of steeper slopes, from which moisture is obtained.

Use and suitability.—Only a small part of this soil is cultivated; the rest is in trees and brush. Yields for some crops are slightly higher than those on Indianola loamy sand, 5 to 15 percent slopes. Use and management practices are similar. This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Indianola loamy sand, 15 to 30 percent slopes (Ic).—This soil generally occupies short, steep slopes in association with the Everett and the Alderwood soils and Indianola loamy sand, 5 to 15 percent slopes. The surface layer is thinner than that of the less strongly sloping Indianola loamy sand, and the depth to sand varies more.

Where Indianola loamy sand, 15 to 30 percent slopes, is closely associated with the Everett or the Alderwood soils, gravel occurs in lenses or is scattered throughout the profile.

Use and suitability.—Except for a few scattered, small areas used with less strongly sloping soils, this soil is in trees and brush. Forestry is the best use. The soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Indianola sandy loam, 0 to 5 percent slopes (Id).—The surface soil is very friable, weakly granular, brown sandy

loam. The depth to sand is slightly greater than in Indianola loamy sand, 5 to 15 percent slopes, but the rest of the profile is similar.

Use and suitability.—This soil has about the same uses and needs the same management as Indianola loamy sand, 5 to 15 percent slopes. Because of the slightly finer texture of the surface soil and greater depth to the sandy substratum, the supply of moisture is slightly higher; consequently, crop yields are generally higher. This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Indianola sandy loam, 5 to 15 percent slopes (Ie).—Stronger relief distinguishes this soil from Indianola sandy loam, 0 to 5 percent slopes.

Use and suitability.—Use and management are similar to those of Indianola loamy sand, 5 to 15 percent slopes. Crop yields are somewhat higher because the surface soil has a slightly finer texture. The supply of available moisture is slightly greater, but it is still low. This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas fir.

JUNO SERIES

The Juno series consists of shallow, fairly coarse textured, brown to reddish brown alluvial soils. They are developing mainly from glacial alluvium that washed from the Shelton soils and their associated till and outwash. The native vegetation consisted of evergreen and deciduous trees and shrubs.

Juno soils occur along small streams that flow from surrounding glacial uplands. They differ from the Belfast soils mainly in that they are somewhat excessively drained and are more droughty and shallower to sand and gravel. In addition, Juno soils occur where there is a wider range of local climate, and they are developing from more basic parent material than the acid igneous glacial sediments of the Belfast soils.

Juno sandy loam, 0 to 3 percent slopes (Jd).—This soil occurs in narrow strips bordering the many small streams that drain the surrounding glaciated areas. The surface soil is a very friable, gravel-free, brown to reddish-brown sandy loam, 6 to 8 inches thick. This layer grades to a loose, single-grained, light-brown sandy loam or loamy sand. At depths of 10 to 24 inches, the sandy loam or loamy sand rests abruptly on a substratum of loose gravel and sand.

The soil varies within short distances. It contains a few channels of sand, silty material, or bars of gravel. Included are a few small areas having a loamy sand or a fine sandy loam surface soil.

This soil is shallow. It is droughty in summer, but crops have ample moisture in spring when the water table is high. Available moisture is exhausted soon after the water table drops.

Use and suitability.—Little of this soil is in cultivation, except where it can be used along with deeper and less droughty soils. Fairly good grazing is obtained on cleared and partly cleared land in spring and again in fall after rains start. In its natural condition, the soil is fair for Douglas-fir and good for cedar, alder, and maple.

This soil is in capability subclass IVs; it is fairly good for fir, redcedar, hemlock, and deciduous trees.

Juno loam, 0 to 3 percent slopes (Jb).—This soil differs from Juno sandy loam, 0 to 3 percent slopes, in having

a loam or silt loam surface soil. The depth to gravel, nature of area, and profile characteristics are otherwise similar.

Use and suitability.—In use and management required, this soil is similar to Juno sandy loam, 0 to 3 percent slopes. It is slightly more productive because the surface soil can hold more available moisture. Pasture grasses and a few grains are grown with fair success, but usually they are damaged during the summer months.

This soil is in capability subclass IVs; it is fair for fir, redcedar, hemlock, and deciduous trees.

Juno gravelly sandy loam, 0 to 3 percent slopes (Ja).—Most of this soil is along stream channels where the gradient is so steep that floodwaters carry gravel and coarse sand. The soil consists of a brown to strong-brown gravelly sandy loam or gravelly loam that becomes more coarse textured with depth. This material rests on loose gravel at depths of 12 to 24 inches.

Use and suitability.—In use and management required, this soil is similar to Juno sandy loam, 0 to 3 percent slopes. It is in capability subclass IVs and is fair for fir, redcedar, hemlock, and deciduous trees.

Juno loamy sand, 0 to 3 percent slopes (Jc).—Most of this soil is along the Union River, in close association with Belfast sandy loam, 0 to 3 percent slopes. The surface soil and upper subsoil are loose, brown and pale-brown loamy sands and sands. The subsoil gives way to grayish-brown, speckled sand at depths of 10 to 24 inches. Faint mottles of yellow and rust brown often occur in the lower subsoil, especially where this soil is adjacent to the Edmonds soils.

Use and suitability.—Coarse texture and a low capacity to hold available moisture prevent the use of this soil for cultivation. It is cultivated only where it adjoins more productive soils. Yields are low, and pastures dry up early in the year. This soil is in capability subclass VIIs; it is fair for fir, redcedar, hemlock, and deciduous trees.

KITSAP SERIES

The Kitsap series consists of moderately well drained, light brownish-gray silty soils on undulating to rolling upland benches. They have developed almost entirely from lake sediments of the Vashon glaciation. The annual rainfall ranges from 45 to 55 inches. The vegetation is a dense forest consisting mainly of Douglas-fir mixed with alder, cedar, and hemlock. The understory is a luxuriant growth of salal, vine maple, willow, and swordfern.

Kitsap soils occur along the borders of inlets and islands of Puget Sound. They are associated with the Alderwood and the Everett soils, but they have neither the hardpan of the Alderwood, nor the gravelly substratum of the Everett soils. Kitsap soils contain well-developed shot.

Kitsap silt loam, 5 to 15 percent slopes (Kb).—This extensive soil occurs along the eastern edge of the county. The surface soil, 6 to 8 inches thick, consists of a granular, friable, light brownish-gray (dark grayish-brown when moist) silt loam. This layer is high in organic matter and contains many small, hard and very hard shot. Below the surface soil, and down to depths of 16 to 20 inches, there is a firm, light brownish-gray to very pale brown silt loam to silty clay loam. This material is faintly mottled with brown and yellowish brown, has a

subangular blocky structure, and contains much less shot than the surface soil. Beginning at depths of 16 to 20 inches and downward to depths of 36 to 40 inches, the material is light-gray silty clay loam. It is faintly mottled with yellowish brown; has a weak, subangular to weak, platy structure; and contains no shot. At depths of 6 feet or more, the subsoil is underlain by firm, platy, slightly compact, light-gray layers of silt and silty clay that are faintly mottled with yellow.

Gravelly glacial till underlies this soil at depths ranging from 3 to 10 feet or more. Roots and water penetrate the lower parts of the profile slowly. The surface soil and subsoil are medium acid; the substratum, slightly acid. Surface drainage is well established; internal drainage is medium. The dense native vegetation controls runoff.

Use and suitability.—This soil is more desirable for farming than the associated soils because of its finer texture and higher capacity to hold available moisture. However, only a small percentage of it is in farms. The acreage farm is used for hay, grains, pasture, and a few plantings of grapes, filberts, and berries. Yields are better than from moist soils of the upland, but less than from fertile soils of the bottom lands.

Nitrogen fertilizer, applied alone or with phosphate, increases the yields of most crops and is necessary for orchard and berry crops. Lime is needed to establish clover on some newly cleared tracts. The dense vegetation and highly permeable soil control runoff and erosion in uncleared areas. Erosion is a serious problem on steep slopes of clean-cultivated fields.

Recently cleared areas need organic matter and nitrogen. These can be obtained through application of barnyard manure, the use of green-manure crops, or use of commercial fertilizer with sod-forming crops.

The soil is in capability subclass IVe and in site classes 3 and 4 for Douglas-fir.

Kitsap silt loam, 0 to 5 percent slopes (Ka).—This soil is associated with Kitsap silt loam, 5 to 15 percent slopes, and differs from it only in slope.

Use and suitability.—Use and management are the same as for Kitsap silt loam, 5 to 15 percent slopes. Tillage is less difficult, and clean cultivated areas are much less susceptible to erosion. The soil is in capability subclass IIIIs and in site classes 3 and 4 for Douglas-fir.

Kitsap silt loam, 15 to 30 percent slopes (Kc).—This soil is on hillsides, gullies, and canyons adjacent to other Kitsap soils. It varies more in depth and texture and has more rapid runoff than the other Kitsap soils.

Use and suitability.—Forestry is the best use of this soil because it is steep and dissected. Trees grow well. Erosion is a serious hazard in the absence of a plant cover. The soil is in capability subclass VIe and in site class 4 for Douglas-fir.

Kitsap silty clay loam, 0 to 5 percent slopes (Kd).—This soil is almost entirely on the southern end of Squaxin Island. It differs from Kitsap silty clay loam, 5 to 15 percent slopes, in that depths to the underlying glacial fill range from 20 to 36 inches. It is closely associated with Sinclair shotty clay loam, 0 to 5 percent slopes.

The surface soil is a very shotty and friable, light brownish-gray (dark grayish-brown when moist) silty clay loam, 6 to 8 inches thick. It is underlain by hard

and firm, gray silty clay or silty clay loam that is shotty and has yellowish-brown and reddish-brown stains along cleavage lines of the bedded sediments. At depths of 20 to 26 inches, or occasionally deeper, the layer just described rests abruptly on a strongly cemented till similar to that underlying the Sinclair soils. Near the coast this till may be within 12 to 18 inches of the surface.

Surface and internal drainage are slow, but the soil usually is not waterlogged nor swampy. Artificial drainage is needed to carry off excess water in winter and early in spring.

Use and suitability.—None of this soil is in farms, but some areas have been cleared and support native grasses. Under proper use, this soil produces good hay and pasture. The forest is dense but not growing so rapidly as on the deeper soils. The understory is luxuriant, especially the salal.

The soil is in capability subclass IVw and in site class 4 for Douglas-fir.

Kitsap silty clay loam, 5 to 15 percent slopes (Ke).—This soil differs from Kitsap silt loam, 5 to 15 percent slopes, mainly in that the subsoil is more compact and has a slightly finer texture to a depth of 30 inches. Below this depth the material is the same as in the Kitsap silt loams. The more compact subsoil affects the profile in several ways. It is more prominently mottled than the profile of Kitsap silt loam, 5 to 15 percent slopes; has slower drainage; and has more definitely developed shot.

Use and suitability.—Use and management are similar to those for Kitsap silt loam, 5 to 15 percent slopes. The soil is in capability subclass IVe and in site class 4 for Douglas-fir.

KOCH SERIES

The Koch series consists of poorly to imperfectly drained, dark grayish-brown soils in broad drainage channels in the glacial outwash plain. The soils have developed from slightly compacted, gravelly drift. The vegetation is a dense stand of deciduous trees and shrubs mixed with sedges and water-tolerant grasses.

The Koch soils are associated with the Grove soils; they have developed from similar parent materials but support a more dense plant cover.

Koch gravelly loam, 0 to 3 percent slopes (Kf).—The surface soil is friable and granular, dark-gray or dark grayish-brown gravelly loam, 5 to 7 inches thick. The subsoil, which reaches to depths of 24 to 28 inches, is hard to firm, massive, grayish-brown gravelly sandy loam, faintly mottled with yellowish brown. It is slightly compacted and has intermittent pockets of partly cemented gravel and sand. The subsoil contains pockets of partly cemented gravel and sand; it grades to loose, well-assorted gravel and sand that continue to depths of many feet.

This soil is medium acid and contains a moderate amount of organic matter. It is wet in winter and spring but dries rapidly when the water table drops in summer. The subsoil is permeable to roots and water.

Use and suitability.—Only a few areas have been cleared and drained, and they are used for pasture. Where surface water can be drained, hay and grains can be grown with moderate yields. Fairly good pasture can be maintained through most of the summer.

This soil is in capability subclass IVw; it is good for mixed forests consisting of red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

Koch silt loam, 0 to 3 percent slopes (Kh).—This soil occurs as small scattered areas. Enough silty material has been deposited to make the surface soil a nearly gravel-free, grayish-brown silt loam. This layer is friable and granular, contains a moderate amount of organic matter, and is rarely more than 5 or 6 inches thick. The underlying horizons are the same as those of Koch gravelly loam, 0 to 3 percent slopes.

Use and suitability.—The use and management are the same as described for Koch gravelly loam, 0 to 3 percent slopes. This soil is in capability subclass IVw; it is good for mixed forests consisting of red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

Koch gravelly sandy loam, 0 to 3 percent slopes (Kg).—This soil differs from the Koch gravelly loams only in texture of the surface soil.

Use and suitability.—This soil is coarser and not so productive as Koch gravelly loam, 0 to 3 percent slopes, but use and management are the same. It is in capability subclass IVw; it is good for mixed forests consisting of red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

LE BAR SERIES

The Le Bar series consists of dark-brown, well-drained soils on gently sloping, low terraces. They have developed from mixed parent material containing large amounts of Astoria soil material. The annual rainfall ranges from 70 to 100 inches. The vegetation is a very dense forest of Douglas-fir, cedar, spruce, and deciduous trees.

Le Bar soils are deep and friable. They have a moderately strong, coarse, granular structure. Their capacity to hold moisture is good. They occur in the southwestern part of the county along streams that originate in the southern Olympic Mountains. They are associated with the Sol Duc and Deckerville soils but are fairly free of gravel in the upper 3 to 4 feet. Le Bar soils differ from the Maytown soils on adjacent bottom land in having a coarse, granular structure and in containing soft shot.

Le Bar silt loam, 0 to 5 percent slopes (Lc).—This soil occurs in the southwestern part of the county. The surface soil is dark-brown silt loam, 4 to 6 inches thick. It contains many small, soft shot. When dry it breaks into very small, sharply angular aggregates, but, when moist, it is moderately granular and friable. To a depth of about 18 inches, the subsurface layer is friable, brown silt loam having a moderate to strong, fine, subangular blocky structure. A few soft shot and infrequent small angular pebbles are in this horizon. The subsoil, a friable, yellowish-brown silt loam, extends to depths of 30 to 34 inches. It contains very few shot and has a moderate, fine, subangular blocky structure. This is underlain by a friable, brownish-yellow silt loam, 10 to 12 inches thick. This silt loam is faintly mottled with reddish brown, contains no shot, and has but little structural development. At depths of 38 to 48 inches, it rests abruptly on the substratum, which consists of firm, yellowish-brown or brownish-yellow gravelly sandy loam. The gravel is rounded to subangular, well graded, and of mixed but dominantly basic igneous origin.

The soil is medium to strongly acid. It has good texture, structure, and capacity to hold available moisture.

Use and suitability.—Isolated location, short growing season, and high rainfall limit the use of this soil for agriculture. A few areas are used for hay and pasture. If nitrogen is applied in the form of barnyard manure or commercial fertilizer, the soil is productive and yields are fairly good.

The original dense forest of Douglas-fir, cedar, hemlock, and spruce has been cut, but logged land has been slow to restock to these species. Many open areas are covered by a dense growth of bracken fern. The soil is in capability subclass IVs and in site classes 1 and 2 for Douglas-fir.

LYSTAIR SERIES

The Lystair series consists of somewhat excessively drained, brown, sandy soils that occupy hilly kettles and kames and nearby level outwash plains. They have developed from nearby gravel-free, loose, sandy glacial drift deposited mainly by outwash waters. The rainfall is 60 to 90 inches a year. The vegetation is a forest consisting mainly of Douglas-fir and some thick stands of lodgepole pine, and there is an understory of kinnickinnick, Oregon-grape, bracken fern, and salal.

The soils are somewhat excessively drained and are droughty. They have a low capacity for available moisture.

Lystair soils occur in the western part of the county in association with the Shelton and Grove soils. They have a redder profile than the Indianola soils. In addition, they have developed from more basic parent material, under higher rainfall, and have darker sandy subsoils and substrata.

Lystair sandy loam, 0 to 5 percent slopes (ld).—This is the most extensive Lystair soil; it occupies gentle slopes in association with other Lystair soils.

In forested areas a 1- to 2-inch layer of loose, partly decomposed needles, leaves, twigs, roots, cones, and moss is on the surface. The mineral surface soil is very friable, single grained, brown (dark reddish brown when moist) sandy loam, 4 to 5 inches thick. It contains firm or slightly hard, irregularly shaped aggregates that are stained by iron, and, in addition, there are a very few shot. The next 12 inches of soil has the same texture but is very friable, massive to single grained, and slightly lighter in color. The subsoil, between 16 and 27 inches, is very friable, single-grained, reddish-yellow (reddish-brown when moist) loamy sand containing no shot.

Below the subsoil is the substratum, which, to a depth of 36 inches, is a massive, light yellowish-brown sand that is firm in place but breaks easily into single grains. It contains much gray and dark gray sand.

Below a depth of 36 inches, the substratum is a variegated light olive-brown and grayish-brown sand. It is massive in place but readily crumbles to loose, single-grained material. Faint yellow and reddish-brown mottles occur irregularly.

A few pebbles are in the profile, especially where this soil merges with the Grove or Shelton soils. The soil is medium to slightly acid and is less acid with depth.

Use and suitability.—A small part of this soil is in subsistence farms and is used for pasture, hay, and small grains. The farm income is mainly from sources off the farm. Most of this soil is in a second-growth

forest of Douglas-fir and hemlock, deciduous trees, brush, and fern. Some areas have a dense stand of lodgepole pine. Because of droughtiness and low fertility, the soil is best suited to forestry. This soil is in capability subclass IVs and site classes 3 and 4 for Douglas-fir.

Lystair sandy loam, 5 to 15 percent slopes (le).—The surface layer of this soil is brown to light brown, and it is slightly more variable in depth than Lystair sandy loam, 0 to 5 percent slopes. There is slightly more runoff because of stronger slopes. All layers of the soil are porous.

Use and suitability.—Use and management are the same as for Lystair sandy loam, 0 to 5 percent slopes. This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Lystair sandy loam, 15 to 30 percent slopes (lf).—This soil is on steep terrace fronts, ravines, and hilly terrain. It is associated with other Lystair soils. It differs from Lystair sandy loam, 5 to 15 percent slopes, in having a thinner, brown to light-brown surface soil. Depths to sand range from 20 to 36 inches. Surface runoff is greater than on Lystair sandy loam, 5 to 15 percent slopes, but it is still low.

Use and suitability.—This soil is in trees and brush because it is steep and droughty. Forestry is its best use. The soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Lystair loamy sand, 0 to 5 percent slopes (b).—This soil differs from Lystair sandy loam, 0 to 5 percent slopes, in texture of the top 12 to 15 inches of soil. The entire profile is somewhat more loose and porous. Depths to the sand substratum range from 25 to 30 inches.

Use and suitability.—All of this soil is in second-growth Douglas-fir, hemlock, and associated deciduous trees and shrubs. Some areas are covered by lodgepole pine. This soil is so droughty and low in fertility that its agricultural uses are limited. Forestry is its best use.

The soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Lystair loamy sand, 5 to 15 percent slopes (c).—This inextensive soil occurs in close association with Lystair loamy sand, 0 to 5 percent slopes, and other Lystair soils.

Use and suitability.—Nearly all this soil is in second-growth forest. Forestry is the best use. This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

MADE LAND

Made land (Ma).—This mapping unit consists of soils that have been modified through dredging, grading, or industrial operations. Made Land is not suitable for agriculture. It is in capability class VIII.

MAYTOWN SERIES

The Maytown series consists of well drained to moderately well drained, brown soils on recently formed flood plains. They are developing from sediment that washed primarily from sandstone, shale, and basalt. The rainfall ranges from 60 to 80 inches a year. The vegetation is a dense forest of maple, alder, cedar, and Douglas fir and a luxuriant ground cover of salal, Oregon-grape, and other brush and shrubs.

Maytown soils are medium acid. The subsoil is characteristically fairly free of mottles or is only faintly mottled.

The Maytown soils are in the southern and western parts of the county. Those occurring along Skookum, Gosnell, and Kennedy Creeks were formed in parent material containing a higher percentage of basalt; consequently, they are redder than those in counties farther south. Maytown soils occur along streams that originate in those southern hills and mountains having mainly Tebo and Astoria soil materials. They differ from the Eld soils in having been formed from a different kind of parent material, and from the Wapato soils in drainage.

Maytown silt loam, 0 to 3 percent slopes (Mb).—The surface soil is friable, granular, brown silt loam (dark brown when moist), 10 to 15 inches thick. This is underlain, to depths of 24 to 28 inches, by subsoil that is firm, reddish-brown silt loam or silty clay loam (dark brown when moist). This material has a weak, subangular blocky structure and contains many small roots. Below depths of 40 to 50 inches, the subsoil is firm, slightly compact, and faintly mottled with darker brown and reddish brown. Below this layer is the substratum, which consists of brown, dark-brown, or yellowish-brown silt loam, silty clay loam, clay, or stratified lenses of these, all faintly mottled with yellow and reddish brown. The substratum is massive, firm, and plastic.

This mapping unit is slightly acid to medium acid, well supplied with organic matter, and slightly plastic when wet. It works easily at most moisture contents. Internal drainage is medium, and surface drainage is adequate. The water table is occasionally high in winter. The soil is overflowed only by extremely high water. It warms early in spring and normally has enough available moisture to mature most crops.

Use and suitability.—This soil is fertile and one of the best in the county. The isolated location of much of the acreage is the main reason that less than half this soil is in farms. In the future, more of it, including areas in tree stumps, will probably be used for agriculture. Permanent pasture and late crops are often damaged late in summer for lack of moisture. Where sprinkler irrigation is used, yields of late crops and pasture are improved.

The soil is used for hay, grains, and pasture in connection with dairying and the raising of beef cattle. The hay consists of red or alsike clover mixed with Italian rye or with timothy, oats, or vetch. Permanent pastures are green well into the summer and again after the fall rains start.

Yields can be maintained through the use of barnyard manure supplemented with phosphate and nitrogen fertilizers. The use of legumes in crop rotations also improves yields.

The soil is in capability subclass II_s; it is good for mixed forests consisting of fir, redcedar, hemlock, and deciduous trees.

MCKENNA SERIES

The McKenna series consists of poorly drained, very dark, gravelly soils in depressions and along natural drainageways. They have developed in Vashon glacial drift, under rainfall that ranges from 45 to 60 inches a year.

The vegetation consists of deciduous trees and shrubs, sedges, reeds, spirea, and wild rose, with occasional thickets of quaking aspen and Oregon-oak. McKenna

soils occur mainly in association with the Alderwood and Everett soils and only rarely with the Grove or Shelton soils. McKenna soils differ from the Norma and Bellingham soils in having very gravelly subsoils and substrata. They are much darker colored than the Koch soils. The Deckerville soils, which closely resemble the McKenna, have developed from more basic parent material.

McKenna gravelly loam, 0 to 3 percent slopes (Mc).—This soil occurs as small scattered areas. The surface soil is friable and granular, dark-gray (nearly black when moist) gravelly loam that is high in organic matter. Below this, to depths of 10 to 15 inches, is firm, dark grayish-brown very gravelly loam or gravelly clay loam that has a weak, subangular blocky structure and is moderately high in organic matter. This grades to firm, massive subsoil consisting of light brownish-gray very gravelly loamy sand. The substratum begins at depths of 24 to 30 inches and consists of slightly to moderately compact, olive-brown and pale-brown coarse gravel and sand that is faintly mottled and stained.

In many areas there is a thin, highly organic silty layer on the surface. The soil is medium acid to strongly acid in all layers. Gravel prevents cultivation. The soil is wet most of the year but dries rapidly in summer.

Use and suitability.—Nearly all this soil is in natural cover. A few areas have been cleared for pasture and grazing. The narrow areas of this soil, and of other McKenna soils, provide green pastures after those on surrounding upland soils have dried.

This soil is in capability subclass IV_w; it is poor for evergreen and deciduous trees.

McKenna loam, 0 to 3 percent slopes (Md).—This soil differs from McKenna gravelly loam, 0 to 3 percent slopes, in that the upper 4 to 8 inches of soil is nearly free of gravel. The highly organic, thin surface layer ranges in texture from loam to silt loam, and it appears to be a deposit of local material. Below the thin surface layer, the profile of this soil is similar to that of McKenna gravelly loam, 0 to 3 percent slopes.

Use and suitability.—Use and suitability are the same as for McKenna gravelly loam, 0 to 3 percent slopes. The soil is in capability subclass IV_w; it is poor for mixed forests of evergreen and deciduous trees.

McMURRAY SERIES

The McMurray series consists of peat that is made up largely of the partly decomposed remains of evergreen and deciduous trees and of various shrubs that have accumulated in swampy basins, depressions, and low intermittent lakes. Uncleared areas are covered by a dense forest of cedar, spruce, fir, hemlock, alder, maple, vine maple, devil'sclub, salal, bracken fern, and occasional areas of skunkcabbage, sedges, and reeds.

The McMurray soils are saturated and must be drained before they can be used. Of the peats in Mason County, the McMurray peat is the least acid and the most fertile and desirable for crops.

The McMurray soils occur as small areas scattered throughout the county.

McMurray peat, 0 to 2 percent slopes (Me).—The upper 8 to 16 inches consists of coarse, woody, dark-brown peat containing many fragments of decaying wood. It is granular and friable. Below this layer the material is less decomposed and consists of brown, fibrous, sedi-

mentary peat. At variable depths below 3 feet, the peat rests on a saturated substratum of partly compact sand and gravel intermixed with silt, clay, and colloidal peat. The gravelly substratum may be many feet deep, but it is commonly within 3 to 5 feet of the surface.

This soil is medium acid, saturated most of the year, and difficult to drain. It generally occurs in small isolated tracts in association with the fair and poor soils of the uplands.

Use and suitability.—This is the most fertile and productive organic soil in Mason County. Only a small acreage is in cultivation, and it is used mainly for pasture and hay. However, it is suitable for small grains and truck crops. This soil will produce good yields of many crops if it is cleared and adequately drained and the water table is lowered. Isolated locations and high costs of clearing and draining prevent greater use for agriculture. The soil is in capability subclass IIIw.

McMurray peat, shallow over gravel, 0 to 2 percent slopes (Mf).—This soil differs from McMurray peat, 0 to 2 percent slopes, in that the thickness of peat over the underlying gravel is less than 24 inches normally in the range of 14 to 24 inches. The surface few inches are similar, but layers vary in the underlying fibrous and sedimentary peat and in the inorganic silts and clays over the gravelly substratum.

Use and suitability.—This soil is not suitable for farming, because of the shallowness of peat and the difficulty of clearing and draining it for cultivation. A few areas are in cultivation, but they are used with other soils. Management is the same as for McMurray peat, 0 to 2 percent slopes. This soil is in capability subclass IVw.

MUKILTEO SERIES

The Mukilteo series consists of peat that is mainly partly decomposed sedges, spirea, twigs, and roots. Peat bogs usually are densely covered by spirea and are generally free of trees and other shrubs. Intermixed with the spirea are various sedges that form a good part of the peat material. Occasionally, Mukilteo peat has a cover of deciduous trees, brush, and shrubs in place of the spirea. Mukilteo peat is widespread throughout the county, and it comprises the largest part of the upland bogs.

This peat is very poorly drained and often ponded many months of the year. Artificial drainage can be used to remove excess moisture. Mukilteo peat is more acid and less fertile than McMurray peat.

Mukilteo peat, 0 to 2 percent slopes (Mg).—The surface layer consists of leaves, twigs, and small roots 1 to 2 inches thick. The upper 10 to 12 inches of peat is a granular, fibrous dark-brown mixture of partly decomposed roots, twigs, and fibrous sedges. This is underlain by more fibrous, less decomposed, brown peat. This grades through fibrous sedge peat, sedimentary peat, or mucky mineral soil to compact glacial till that is at varying depths below 3 feet. Occasionally, a thin layer or layers of diatomaceous earth occurs within 1 or 2 feet of the surface.

This soil is strongly acid. It is saturated throughout the year and is difficult to drain.

Use and suitability.—Only a few areas are cultivated in the county. Where adequate drainage can be installed and maintained, good yields of hay, grain, and pasture

can be obtained. Uncultivated cleared areas are rapidly covered by native vegetation. This soil is in capability subclass IIIw.

Mukilteo peat, shallow over gravel, 0 to 2 percent slopes (Mh).—This soil differs from Mukilteo peat, 0 to 2 percent slopes, in that the gravelly substratum is normally at a depth of 14 to 24 inches.

Use and suitability.—Use and suitability of this soil are the same as for Mukilteo peat, 0 to 2 percent slopes. The soil is in capability subclass IVw.

NASEL SERIES

The Nasel series consists of dark reddish-brown, well-drained, gravelly soils. They occupy the high terraces formed at the outlets of glacial streams. They have developed under prairie conditions from mixed glacial material, which was modified by considerable amounts of locally incorporated shale, basalt, and old terrace material similar to that of the Illoquiam soils. The rainfall is 60 to 80 inches a year. In most areas the spread of forests has modified, to some extent, the nearly black color of these true prairie soils. The first settlers found a few areas of Nasel soils still in prairie. In this county the Nasel soils occur along lower Cloquallum Creek.

Nasel gravelly loam, 0 to 5 percent slopes (Na).—This inextensive soil occurs in the southwestern part of the county. The surface soil consists of softly granular and friable, strongly acid, dark reddish-brown (very dark brown when moist) gravelly loam, 6 to 8 inches thick. It is free of shot, high in organic matter, and contains many small roots. Below this layer, and to depths of 12 to 18 inches, the soil material is friable, reddish-brown gravelly sandy loam or gravelly loam having a weak, subangular blocky structure. It is underlain by a less gravelly, friable, brown gravelly loam that has a weak, subangular blocky structure. This last-named layer grades to a yellowish-brown, slightly compact gravelly loam that is faintly mottled with yellow and reddish brown. The substratum begins at depths varying from 24 to 45 inches; it is a light yellowish-brown, compact mixture of waterworn gravel, sand, and clay. This substratum is not cemented, but water and roots do not penetrate it readily. It is several feet thick.

This soil has a higher capacity to hold available moisture, and it is more fertile than other soils occupying the Carstairs Prairie. The soil is medium acid to strongly acid.

Use and suitability.—Most of this soil is used for hay, grain, or pasture. Yields are a little higher than those of other Carstairs Prairie soils. Nitrogen and organic matter can be maintained by applying 6 to 8 tons an acre of barnyard manure. Phosphate and nitrogen fertilizers improve the yields of clover and pasture. Lime can improve this acid soil.

This soil is in capability subclass IIIIs and in site class 4 for Douglas-fir.

NORDBY SERIES

The Nordby series consists of well-drained, brown soils on undulating or gently sloping terraces and in the stream troughs of shallow glacial lakes. They have developed from glacial lake sediment that was modified with metamorphic and basic igneous rock from the lower slopes of the Olympic Mountains. The rainfall is 80

to 100 inches or more a year, including 1 to 2 feet of snow. The vegetation is mainly Douglas-fir, which is of better quality than that growing on the associated Hoodsport soils.

The soils occur on the upper glacial moraine adjacent to the eastern slopes of the Olympic Mountains in association with the Hoodsport soils.

The Nordby soils differ from the Cloquallum soils in that they contain much coarser material, have less structural development, and are shallower to the unrelated underlying material.

Nordby loam, 0 to 5 percent slopes (Nb).—This soil is near Lake Cushman. At the surface there is about an inch of dark-brown organic litter. The upper 4 to 5 inches of mineral soil consists of granular and friable, brown or dark reddish brown, gritty loam that contains many small, reddish shot. This material grades to friable, reddish brown loam having a weak, subangular blocky structure. The subsoil, beginning at a depth of about 16 inches, consists of firm and friable, reddish-yellow loam having a weak, subangular structure. At depths of 32 to 36 inches, the subsoil rests on the substratum, which consists of stratified sand, small gravel, loam, and silt loam. The substratum is dark grayish brown, brownish yellow, and reddish yellow. In a few areas, the substratum is as much as 60 inches deep. The gravel is loose, rounded to subangular, and highly coated with iron and manganese.

The soil is medium acid to strongly acid, and it has a fair capacity to hold available moisture.

Use and suitability.—This soil is not located in the farming areas. Its use for agriculture is severely limited by frost hazard and high rainfall. The best use is forestry. The old-growth timber has been cut, and the second-growth Douglas-fir is in various age classes. Some fairly pure stands of alder and maple occur. Trees grow rapidly because the soil is deep and moisture is abundant.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas fir.

Nordby loam, 5 to 15 percent slopes (Nc).—This soil is associated with Nordby loam, 0 to 5 percent slopes, but differs in occasionally having fine sandy material on the surface and in being more variable in depth to the underlying material. In addition, surface runoff and internal drainage are slightly more rapid and the soil dries earlier.

Use and suitability.—Use and suitability are the same as for Nordby loam, 0 to 5 percent slopes. This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

NORMA SERIES

The Norma series consists of poorly drained, very dark, highly organic soils in upland depressions. They have developed from coarse sandy drift under the influence of excessive moisture. The rainfall is 45 to 60 inches a year. The vegetation is alder, vine maple, willow, spirea, wild rose, skunkcabbage, and, in scattered marshy areas, reeds and sedges.

These soils occur in association with the Alderwood, Everett, and Indianola soils. Norma soils do not have the fine-textured subsoil typical of the Bellingham series, nor the very gravelly subsoil of the McKenna series, nor the iron oxide cementation of the Edmonds series.

Norma silt loam, 0 to 3 percent slopes (Ne).—This soil occurs as small areas scattered throughout the eastern two-thirds of the county. At the surface is a thin, organic mat of leaves, twigs, and moss. Under this litter is a highly organic, friable, dark-gray (nearly black when moist) silt loam, 5 to 8 inches thick. This grades to a friable, weakly granular, dark grayish brown, or dark-gray and olive-gray fine sandy loam, which ranges from 4 to 12 inches in thickness. This last-named material contains much less organic matter than the surface soil and is faintly mottled with reddish brown and yellowish brown. Below this layer is the subsoil, a massive, friable, slightly compact, light brownish-gray loamy sand, moderately mottled with reddish brown and reddish yellow. Mottling becomes less intense and the texture becomes coarser with depth. There are a few reddish-brown lenses, cemented by iron, in the subsoil. The substratum, consisting of compact, light-gray gravelly sandy drift, is at depths of 24 to 32 inches.

The soil is saturated with water in winter and spring. In dry summers the water table drops below 3 feet. To be suitable for crops, the soil must be drained.

Use and suitability.—A small acreage has been drained, cleared, and used for agriculture. This land is nearly always farmed along with other soils. Partly cleared, drained areas are used for pasture. Unless drainage is adequate and pasture grasses are maintained, undesirable plants soon take over. This soil is more easily drained than many of the other basin soils because its subsoil is more permeable and allows the use of open drainage ditches. This soil is fertile and productive if properly drained. Management is similar to that of the Bellingham silt loam.

This soil is in capability subclass IIIw; it is fair for mixed forests consisting of red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

Norma sandy loam, 0 to 3 percent slopes (Nd).—This soil differs from Norma silt loam, 0 to 3 percent slopes, in texture of the surface soil.

Use and suitability.—In suitability and use, this soil is similar to Norma silt loam, 0 to 3 percent slopes. This soil is in capability subclass IIIw; it is fair for mixed forests of red alder, Oregon maple, willow, hemlock, spruce, and redcedar.

NUBY SERIES

The Nuby series consists of poorly or imperfectly drained, light brownish-gray soils on bottom lands. They have developed under restricted drainage from granitic glacial material that washed from the surrounding glacial uplands. The annual rainfall is 40 to 70 inches. The native vegetation is a dense deciduous forest containing scattered cedar and spruce. The understory is mainly a dense growth of vine maple, willow, devilsclub, and water-tolerant sedges and grasses. Spirea and wild rose grow in partly cleared areas.

Nuby soils are medium acid, and they have distinct yellowish-brown and rust-colored mottles in the subsoil.

Nuby soils occur in association with the Belfast soils along small streams, mainly in the eastern and northeastern parts of the county. In the eastern part, the Nuby soils occur only as scattered and isolated tracts. Nuby soils differ from the Wapato soils in that they have developed mainly from reworked glacial drift rather than

from mixed basaltic and sedimentary parent material, and they do not have the highly developed granular structure. They differ from Skokomish soils in nature of parent material.

Nuby silt loam, 0 to 3 percent slopes (Nf).—The surface soil consists of weakly granular, friable, light brownish-gray silt loam, 8 to 12 inches thick. To depths of 11 to 24 inches, the material is friable silt loam faintly mottled with rust brown. Below this, and down to depths of 26 to 36 inches, there is friable to firm, massive, gray silt loam subsoil that is distinctly and finely mottled. The substratum consists of loose to firm, massive, stratified sand and silt, or pockets of each, in no definite arrangement.

The soil normally is sandier as depth increases, and it is often gravelly below depths of 4 to 5 feet. Strata of fine sand may occur in any of the horizons, but they are rarely found in the surface soil and upper subsoil. A few lenses of peat occur in the lower subsoil, particularly near tidal flats. Along Dewatto Creek, there are a few lenses of diatomaceous earth in the subsoil. Included are a few small, low areas in which the soil is wetter and more highly mottled, as well as a few small areas, totaling about 50 acres, on which the surface soil is silty clay loam.

The soil requires surface drainage before it can be farmed. Even so, the water table is within 1 or 2 feet of the surface in winter and spring, and, in wet periods, water may cover the surface. Complete drainage is difficult because drainageways do not have enough gradient. Crops are planted late to escape flooding.

Use and suitability.—Less than one-fourth the acreage is in farms, but, where the soil occurs in large enough areas, it is used for crops. Use of this soil is limited by its isolated location, by high costs of clearing, and by the closely associated, unproductive soils. The main crops are hay and pasture, but oats, vetch, corn, and peas have also been grown.

Yields can be increased by applying superphosphate and 6 to 8 tons of barnyard manure per acre. Other fertilizer requirements are not known.

This soil is in capability subclass IIIw; it is good for mixed forests of redcedar, red alder, and Oregon-maple.

ORCAS SERIES

The Orcas series consists mainly of sphagnum moss. Among the plants on these peat bogs are the fairly rare, insect-catching sundew plants and wild cranberry. The cranberry is an indicator of very acid conditions. The yellowish-green sphagnum moss and Labrador-tea, or ledum, mixed with a few scattered lodgepole pines, give these bogs a distinctive appearance.

The bogs are open and easily traversed; during winter months they are flooded. The water table is near the surface most of the year.

Orcas peat, 0 to 2 percent slopes (Oa).—The upper 12 to 16 inches is composed almost entirely of raw, fibrous and spongy, yellowish-brown sphagnum moss. Under this, the peat is much the same, though slightly compact and slightly lighter colored. The peat varies but little down to the substratum of gravelly till, which is at depths ranging from 3 to 20 feet or more.

Use and suitability.—This mapping unit is extremely acid, infertile, and unfit for agricultural use. It is har-

vested to some extent for use as packing and mulch material. This soil is in capability class VIII.

Orcas peat, shallow over gravel, 0 to 2 percent slopes (Ob).—This peat differs from Orcas peat, 0 to 2 percent slopes, only in that the depth to underlying gravel is less than 2 feet. Normally the gravel is 12 to 18 inches from the surface.

Use and suitability.—The use is the same as for Orcas peat, 0 to 2 percent slopes. This soil is in capability class VIII.

PILCHUCK SERIES

The Pilchuck series consists of somewhat excessively drained, sandy and gravelly soils on bottom lands adjacent to rivers. They are developing from mixed alluvium. The soils are above ordinary floods but are flooded when water is extremely high. They are very droughty because the surface soil and subsoil are porous.

The Pilchuck soils are associated with the Skokomish, Dungeness, and Puget soils and were derived from similar parent material. They differ from these soils in texture and drainage and in developing from much more recently deposited parent material. Pilchuck soils differ from the Belfast and Juno soils in color and in origin of parent material. The Pilchuck soils are not uniform for any considerable distance.

Pilchuck gravelly loamy sand, 0 to 3 percent slopes (Pc).—This soil occurs mostly along the Skokomish River and its tributaries. It resembles Riverwash, a miscellaneous land type, but occurs above it. The surface soil is a thin, light brownish-gray gravelly loamy sand. It is underlain by gray, stratified or unassorted, loose, porous sand and gravel. Brush, grass, and alder have become established in a few places.

Use and suitability.—This soil is used only for pasture. Grasses are severely damaged in dry weather. The soil is in capability subclass VII_s; it is poor for forestry.

Pilchuck loamy sand, 0 to 3 percent slopes (Pb).—This soil differs from Pilchuck gravelly loamy sand, 0 to 3 percent slopes, in that it occupies the more stable, higher benches that are less subject to annual flooding. The surface soil is slightly acid, light brownish-gray loamy sand, 8 to 12 inches thick, that contains only a small amount of organic matter. This is underlain by gray or light brownish-gray sand, which becomes stratified with gravel and cobbles at depths of 24 to 30 inches. The entire profile is loose, porous, and single grained. Internal drainage is very rapid and is inhibited only by an occasional high water table in winter.

Use and suitability.—Most of this soil is in deciduous trees, brush, and grass. A few cleared areas have been seeded to permanent pasture, but yields of forage are low because of the droughtiness of the soil. Most cleared areas are farmed with better associated soils. This soil is in capability subclass VI_s; it is poor for forestry.

Pilchuck sand, shallow, 0 to 3 percent slopes (Pc).—This soil occurs with other Pilchuck soils; it differs from them in having the coarse, gravelly substratum much nearer the surface, usually within 6 to 15 inches. The soil is exceedingly porous and droughty.

Use and suitability.—The few acres of this soil in farms are used for pasture. The forage allows only sparse grazing. This soil is in capability subclass VII_s; it is poor for forestry.

PUGET SERIES

The Puget series consists of poorly drained, light brownish-gray soils on low, swampy bottom lands. They are developing from recent alluvium in association with the Pilchuck, Dungeness, and Skokomish soils. The subsoil is highly mottled; frequently the mottling begins near the surface. The native vegetation is deciduous trees and water-tolerant shrubs, grasses, and sedges.

Puget silt loam, 0 to 2 percent slopes (Pd).—This soil occurs in the lower reaches of the Skokomish River Valley. The surface soil, a friable, slightly acid, light brownish-gray silt loam, is 8 to 12 inches thick and faintly mottled with brown and yellowish brown. Below this, and to depths of 20 to 26 inches, is subsoil consisting of slightly plastic, firm, gray silt loam or silty clay loam that is highly stained and mottled with red and yellowish brown. The underlying material is highly mottled silt and moderately plastic, stratified clay and silty clay. Bluish colors are fairly common in the substratum.

The soil is swampy and waterlogged most of the year. Many areas have a 3- to 4-inch layer of sedge peat on the surface. A large area of this soil near the tidal flats is much less uniform than that described. Here the profile has stratified lenses of sand, silt, and peat at various depths, or on the surface.

Use and suitability.—Around the fringes of the better drained soils, a small acreage of this soil has been cleared for farming. Unless it is adequately drained, use of the soil is limited by waterlogging. Drainage is difficult because the soil is in a low position, and water moves slowly through it. However, if properly drained, the soil is highly fertile and productive, and management is similar to that of the Skokomish soils. Most of the acreage is covered by deciduous and cedar trees, or it is in a semimarsh condition. This soil is in capability subclass IIIw, and it is good for mixed forests of red-cedar, red alder, and Oregon-maple.

RIVERWASH

This land type consists of poorly assorted sand, gravel, and cobbles bordering streams and rivers or recently abandoned river channels.

Riverwash, 0 to 3 percent slopes (Ra).—This mapping unit is frequently overflowed and changed by erosion and deposition. The material is sparsely covered by vegetation, and it has no agricultural value. It is in capability class VIII.

ROUGH BROKEN LAND

This land type consists of escarpments and steep slopes along entrenched stream channels, beach bluffs, and other steep, broken areas.

Rough broken land (Rb).—The soil, where it has been formed, is shallow, gravelly, and variable, but it has some characteristics of the dominant upland soil in the vicinity. The vegetation is variable, and its composition depends on aspect, seepage, and depth of soil. This mapping unit has no agricultural value and should be left in its natural cover to prevent erosion. It is in capability subclass VIIe.

ROUGH MOUNTAINOUS LAND

Rough mountainous land consists of high mountainous terrain and outlying steep foothills.

Rough mountainous land, Hoodsport soil material (Rc).—This miscellaneous land type is adjacent to Rough mountainous land, Tebo soil material. It is not so mountainous nor so rough as the latter land type. It normally occupies the lower elevations below the Tebo soils. Slopes are generally between 30 and 60 percent. Included are a few areas having slopes of less than 30 percent.

The dominant parent material, of mixed glacial origin, is similar to that of the Hoodsport series. A greater percentage of basic igneous rock is in the parent material, and, in places, the depth to underlying igneous bedrock is less than 6 feet. Outcroppings of rock occasionally occur.

Soil characteristics are not well developed. Steep slopes and rock outcroppings have resulted in shallow, variable, and stony soils. In general, the characteristics of these soils closely resemble those of the Hoodsport series, but they are more variable in depth, texture, and stoniness. The depth to the cemented substratum and the degree of cementation are extremely variable from place to place.

Douglas-fir and hemlock were the dominant timber species. Most of the land type has been logged, but trees similar to the original species are restocking most areas. Some areas are restocking with alder, maple, willow, and brush.

Use and suitability.—Forestry is the best use of this land type. Tree growth varies according to the depth of the soil material.

This mapping unit is in capability subclass complex—VIE and VIIe and in site classes 4 and 5 for Douglas-fir.

Rough mountainous land, Tebo soil material (Rd).—This miscellaneous land type occurs mainly on the higher mountainous and outlying steep foothills. Small acreages of inaccessible arable land are included. Slopes are dominantly in the range of 30 to 70 percent. However, small areas having slopes of more than 70 percent and less than 30 percent are included.

The dominant parent material is weathered basaltic or andesitic rock and considerable mixed glacial material.

Soil profile characteristics are not too well defined. The soils are normally shallow and stony, and rock outcrops are numerous. In general, the soils closely resemble those of the Tebo series, but they are more variable in depth and in stoniness. The depth to underlying bedrock varies from a few inches to 6 feet or more.

The dominant vegetation is Douglas-fir, hemlock, and the normally associated ground cover. Grand fir, Sitka spruce, alder, and maple are scattered throughout the forest, especially in the more moist sites and in logged areas. Alpine, noble, and Pacific silver fir are at elevations above 3,000 feet. Dense vegetation protects the slopes from erosion, although runoff is rapid on the steeper slopes.

Use and suitability.—Forestry is the best use of this land type. Most of the virgin timber has been cut, but many trees are still available for harvest.

In most instances, selective logging and careful forest management are practiced. The future of the lumber industry in the county largely depends on the cutting practices and reforestation of these mountainous areas.

This land type is in capability subclass complex—VIE and VIIe and in site classes 2 and 4 for Douglas-fir.

Rough mountainous land, Tebo-Shelton complex (Re).—This land type occurs as transitional areas on foot slopes between Rough mountainous land, Tebo soil material, and the Shelton soils. Slopes are in the range of 30 to 50 percent, but small areas are included that have slopes of less than 30 percent. The parent material consists mainly of weathered basic igneous rock and glacial till. Soil characteristics are extremely variable. Profiles resembling those of the Tebo and Shelton series, and profiles transitional between these two series, occur in this land type. Rock outcrops occur occasionally. The various profiles occur in such an intricate pattern that their separation was not practicable. Runoff is rapid, but the dense vegetation prevents erosion damage.

Use and suitability.—All of this land type is in forest—the use to which it is best suited. Forest management is similar to that on other steep or mountainous areas.

This land type is in capability subclass complex—VIe and VIIe and in site classes 2 and 4 for Douglas-fir.

SAXON SERIES

The Saxon series consists of friable, well-drained, brown, silty soils on the uplands. They have developed from Vashon glacial lake sediment similar to that of the Kitsap soils. Surface drainage is well developed, internal drainage is medium, and the moisture-holding capacity is good. The rainfall is 45 to 60 inches a year. The vegetation is a dense forest of fir, cedar, and alder, with a dense undercover of salal, vine maple, bracken fern, and sword fern. Saxon soils differ from the Kitsap soils in having browner surface soil and less dense subsoil, and in containing shot.

Saxon silt loam, 5 to 15 percent slopes (Sa).—This soil occurs on rolling or gently rolling benches near Belfair. The surface soil is friable and moderately granular, brown silt loam, 8 to 10 inches thick. It is slightly acid and contains many roots and very little shot. This is underlain by a pale-brown, friable silt loam, which at depths between 15 and 20 inches grades to a friable to firm silt loam subsoil having a weak, subangular blocky structure. Yellowish-brown stains occur along root channels. Below a depth of 30 inches, the subsoil grades to slightly compacted, stratified, and platy fine sand and silt, which continue to depths of several more feet. The slight compaction in this material does not restrict movement of moisture or growth of roots.

The soil is deep, friable, and permeable; it has a good capacity to hold available moisture.

Use and suitability.—Much of this soil has been cleared and is used mainly for hay, grain, and pasture. Vegetables are grown for local markets and for home use on many small, intensively farmed garden plots. Yields of crops compare favorably with those on the best upland soils, and they are only slightly less than those obtained on the better flood-plain soils. Though the soil is moderately fertile, nitrogen and organic matter must be maintained through additions of barnyard manure, or through use of green-manure crops. Commercial nitrogen fertilizer benefits garden crops and, when it is used with phosphate, additional benefits are obtained.

This soil is in capability subclass IVe and in site class 3 for Douglas-fir.

SEMLAHMOO SERIES

The Semiahmoo series consists of very poorly drained, dark-brown muck. It originally was Mukilteo peat, but the upper several inches has been highly decomposed through natural means or cultivation. Only a few small areas occur in the county. The natural vegetation is similar to that on Mukilteo peat.

Semiahmoo muck, 0 to 2 percent slopes (Sb).—The upper 6 to 12 inches is friable and granular, dark-brown or dark grayish-brown, highly decomposed peat in which a few plant remains are recognizable. It contains only a small amount of mineral soil. Below this, the brown, fibrous peat is only partly decomposed, and it is similar to Mukilteo peat. At variable depths below 3 feet, this partly decomposed peat grades through sedimentary peat to a substratum of compact gravelly till.

In a few scattered spots a 1- to 4-inch layer of diatomaceous earth, chalklike in appearance, occurs in the upper 12 to 18 inches of muck. When this chalky layer is near the surface, the plowed soil is light gray. The muck is strongly acid.

Use and suitability.—This muck is fertile and good for grain, hay, and pasture. It is difficult to drain and clear. Abandoned areas are quickly covered by a dense stand of spirea. This soil is in capability subclass IIw.

Semiahmoo muck, shallow, 2 to 10 percent slopes (Sc).—This soil occurs in spots where the surface soil is highly decomposed peat, 8 to 12 inches thick. It is underlain by peaty material or by highly organic silt, clay, and sand. This soil is extremely variable within short distances.

Use and suitability.—This soil has little agricultural value other than for a limited amount of grazing on the partly cleared areas. This soil is in capability subclass IVw.

SHELTON SERIES

The Shelton series consists of well-drained, brown soils on uplands. They have developed mainly from continental glacial till mixed with considerable basaltic rock of local origin and with local drift from the Olympic Mountains. The cemented till is at depths of 30 to 36 inches. The annual rainfall ranges from 60 to 90 inches. The native vegetation is a dense forest consisting almost entirely of Douglas-fir and a dense understory of Oregon-grape, vine maple, and huckleberry.

Shelton soils are dominant on the rolling moraines in the southern and western parts of the county. They are similar to the Alderwood soils but have developed under more rainfall, and they are redder in color and deeper. The Shelton soils differ from the Hoodsport soils at lower altitudes in that they are deeper and less stony and, in formation, have been influenced less by basaltic material.

Shelton gravelly sandy loam, 5 to 15 percent slopes (Sf).—This very extensive soil occupies undulating to rolling glacial moraines. The organic surface layer is 1 to 2 inches thick. The upper surface soil is friable, weakly granular, brown gravelly sandy loam, 3 or 4 inches thick. It is medium acid. At a depth of about 4 inches, the material is strong-brown to nearly reddish-yellow gravelly sandy loam. This contains less organic matter and more shot than the surface layer and has a very weak, granular structure, or it is single grained. When the soil

is cultivated, this layer and the surface layer can no longer be distinguished. From depths of 12 to 14 inches, and down to 25 inches, the subsoil is a reddish-yellow very gravelly sandy loam. This material is very friable and is massive to single grained. It is faintly compacted. Gravel in this layer and in the layer above is moderately coated with fine, reddish-brown material.

Between the subsoil and the indurated till below is a 5- to 7-inch transitional layer that contains less clay than the layer above, is slightly compacted, and often has the color of light gray or yellow. At depths that normally vary from 30 to 36 inches, the soil rests abruptly upon an indurated, gravelly till, the upper 6 to 16 inches of which is very compact. The till often has a weak, platy structure and is colored reddish, light yellowish brown, and yellowish brown. This upper part fractures to irregular fragments of angular and rounded gravel, which are cemented together. Below this and to depths of many feet, the till is cemented, light brownish-gray to grayish-brown gravelly sandy loam that is streaked with yellow and reddish brown. This till is a mixture of acid and basic igneous material, which distinguishes it from the predominantly acid igneous rocks of the typical Vashon, or continental, till.

The cemented substratum slightly restricts the downward movement of moisture, but not enough to hold moisture through long dry spells.

Use and suitability.—This is one of the dominant soils in the county, but little of it is in farms. The few areas in cultivation are nearly always used with better soils of the uplands or the bottom lands. The main crops are hay and small grains. The soil is occasionally used for pasture, fruit, and berries. Yields are fairly low and are similar to or slightly better than those obtained from the Alderwood soils.

Crops may be damaged in summer through the lack of moisture, as well as through lack of plant nutrients. The soil needs organic matter and nitrogen. Barnyard manure is most commonly used as the source of nitrogen and organic matter. Green-manure crops grown in rotations and fertilized with nitrogen and phosphate also improve yields.

Nearly all this soil has been logged and is in second-growth forest, mainly Douglas-fir. Many areas are managed for Christmas trees, but a few areas are managed for timber. Most of the soil is in site classes 3 and 4 for Douglas-fir, but a few areas are in site classes 2 and 5. Reasons for the variation in site class are not definitely known but are believed to be associated with the depth of the soil to underlying till. In the poorest sites, this depth is around 25 inches; whereas, in the best sites it is 35 inches or more. Within short distances, variations in depth to till result in differences in the growth of trees. Management of forests for timber should be encouraged on this soil. Yields are generally higher than on the Alderwood and Hoodsport soils, both of which are shallower.

This soil is in capability subclass IVs and site classes 3 and 4 for Douglas-fir.

Shelton gravelly sandy loam, 0 to 5 percent slopes (Se).—This soil occurs in areas large enough to be separated from Shelton gravelly sandy loam, 5 to 15 percent slopes. The profile is similar, except in about 150 acres that have a surface soil of gravelly loam.

Use and suitability.—Other than possibly a slightly better moisture-holding capacity, this soil is like Shelton gravelly sandy loam, 5 to 15 percent slopes. It is used in the same way.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Shelton gravelly sandy loam, 15 to 30 percent slopes (Sg).

(Sg).—This extensive soil occupies hilly ridges and drainageways. In depth and in content of stone and gravel, it is more variable than the less steep Shelton gravelly sandy loams, but it is normally only a few inches shallower. In spots the underlying till is only partly cemented, but, in the rest of the acreage, cementation is continuous. Surface drainage is more rapid than on Shelton gravelly sandy loam, 5 to 15 percent slopes, and the soil is slightly more droughty.

Use and suitability.—Because of strong slopes, none of this soil should be cleared. Under natural conditions, erosion is held in check by dense vegetation. The forest is mainly second-growth Douglas-fir, which grows fairly well but not so rapidly as on Shelton gravelly sandy loam, 5 to 15 percent slopes. Site classes are variable on this soil because of the many different directions of slope and conditions of drainage. The growing of Christmas trees on this soil is limited because of the difficulty of cutting and hauling on the strong slopes. The growing of timber requires that desirable species restock the soil and be properly managed.

This soil is in capability subclass VIIs. It is mainly in site classes 3 and 4 for Douglas-fir, though some of the ridges and south slopes are in site class 5.

Shelton gravelly sandy loam, 30 to 45 percent slopes (Sh).

(Sh).—This soil occupies the rough, broken, steep hillsides, escarpments, and gullies in areas surrounded dominantly by less strongly sloping Shelton soils. The soil varies considerably in depth and texture, but its most consistent characteristic is the strongly cemented underlying till. Surface runoff is more rapid than on other Shelton soils.

Use and suitability.—Forestry is the best use of this soil. The rate of growth and quality of timber depend on local soil conditions. The natural cover allows only the minimum of erosion.

This soil is in capability subclass VIe and in site classes 3 and 4 for Douglas-fir.

Shelton gravelly loam, 5 to 15 percent slopes (Sd).

Nearly all of this soil is 5 to 6 miles west of Shelton. It differs from Shelton gravelly sandy loam, 5 to 15 percent slopes, in texture of the surface soil and subsoil and in being 2 to 5 inches deeper to underlying till. The few areas bordering the Cloquallum soils are also different in that the surface soil is more finely textured because of the influence of Cloquallum parent material.

This soil has a better available moisture-holding capacity than Shelton gravelly sandy loam, 5 to 15 percent slopes.

Use and suitability.—None of this soil is in cultivation. All of it has been logged, and now it has a second-growth forest of fir trees about 20 to 60 years of age. Tree growth is better than that on Shelton gravelly sandy loam, 5 to 15 percent slopes. Crops should also yield better.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

SHELTON-ASTORIA COMPLEX

This complex occurs north of Matlock near the farthest westward advance of the Vashon Glacier. In this area, glacial deposits were intermittent and of variable depth and degree of compaction. The till and shales are intermixed to some extent and have weathered to soils that resemble both the Astoria and the Shelton series. In some places each of these soils has developed, but they occur in an intricate pattern.

Shelton-Astoria complex, 5 to 15 percent slopes (Sk).—The surface soil is a friable, brown loam containing scattered glacial gravel. The upper subsoil is yellowish-brown loam or silt loam containing scattered gravel. The lower subsoil is less clearly defined, and its character depends on the extent of the till in the parent material. It is usually a yellowish-brown loam containing a mixture of glacial gravel and fragments of shale and soft, weathered sandstone. At depths of 30 to 50 inches, the subsoil rests on typical Astoria parent material, which consists of strongly weathered shale and soft sandstone. All layers of the profile are strongly acid. Where the parent materials were not intermixed, the soils are similar to Shelton gravelly sandy loam and to Astoria silt loam occurring on equivalent slopes. The soils in this mapping unit have a high capacity to hold available moisture.

Use and suitability.—All of this complex is in second-growth forest of fir, cedar, hemlock, alder, and maple.

This soil is in capability subclass IVs and in site class 2 for Douglas-fir. After harvest of timber, provisions should be made to assure the restocking of fir, as maple and alder rapidly invade logged areas.

Shelton-Astoria complex, 15 to 30 percent slopes (Sm).—Except for stronger slopes, this mapping unit is like Shelton-Astoria complex, 5 to 15 percent slopes.

Use and suitability.—In use and suitability, this soil is like Shelton-Astoria complex, 5 to 15 percent slopes.

This mapping unit is in capability subclass VIIe and in site class 2 for Douglas-fir.

SINCLAIR SERIES

The Sinclair series consists of moderately well drained, brown, shotty soils on uplands. They have developed from very compact Vashon gravelly glacial till in rainfall that ranges from 45 to 55 inches a year, the lowest in Mason County. The vegetation is a forest, mainly excellent Douglas-fir mixed with cedar, maple, and alder. The understory is a luxuriant growth of swordfern, Oregon-grape, vine maple, salal, and huckleberry. Compared to the vegetation on drier adjacent soils, there is very little madrone and manzanita, but there is considerable cedar.

Surface drainage is moderately well established. Internal drainage is medium, except that it is restricted by the cemented substratum.

Sinclair soils are near Puget Sound on the eastern edge of the county and on the islands of Case Inlet. They are commonly on lower slopes adjacent to the Harstine and Alderwood soils. They are grayer, more finely textured, and more shotty than either the Alderwood or the Harstine soils. In addition, the underlying till, in most places, is more cemented.

Sinclair shotty loam, 5 to 15 percent slopes (So).—This gently rolling and rolling soil is the dominant soil of

the Sinclair series. A thin, very dark brown, acid, organic mat is on the surface. The upper 3 to 4 inches of mineral soil is medium acid, granular and friable, grayish-brown shotty loam (very dark grayish brown when moist). This is underlain by medium acid, friable and granular, light brownish-gray shotty loam that continues to depths of 10 to 12 inches. The shot are grayish and very pronounced. This shotty loam is underlain by very pale brown gravelly loam subsoil that reaches to depths of 20 to 24 inches. It is faintly stained and mottled with yellowish brown and light gray and is massive or has a weak, subangular blocky structure. The gravelly loam is hard when dry but friable when moist; it contains much less shot than the horizons above. Between the subsoil and the underlying till is a more sandy layer, 3 to 6 inches thick, that is firm and moderately mottled, contains very few shot, and is massive. The firm till very abruptly changes to cemented till at depths of 28 to 42 inches. The upper 2 to 6 inches of cemented till is, normally, a sequence of thin plates consisting of mottled and stained, strongly cemented, grayish gravelly sandy loam. To depths of many feet, the till is granitic, light gray, strongly cemented, and strongly acid.

On the lower concave slopes, the subsoil is more highly mottled. In some places this soil is hard to distinguish from shallow deposits of Kitsap soil material overlying till.

Surface drainage is well to moderately well established. Internal drainage is restricted by the cemented till. Because of finer texture, the capacity to hold available moisture is better than it is in the associated Harstine and Alderwood soils of the uplands.

Use and suitability.—A higher percentage of this soil is in farms than of any of the other "hardpan" soils of the uplands. It is more favorably located and can supply moisture to plants in the dry summer months. There is a longer frost-free season for crops because the soil is on slopes adjacent to Puget Sound.

The soil is used for grapes (fig. 4), loganberries, raspberries, filberts, hay, grain, and pasture. Grape yields



Figure 4.—Sinclair shotty loam, 5 to 15 percent slopes, used for grapes.

vary considerably from season to season. The Island Belle variety, a grape similar to the Concord, is the main grape, and it yields well in the cool climate of Mason County. White grapes are not so well suited, but the White Diamond variety is grown. The grapes are processed into grapejuice or wine by local wineries.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Sinclair shotty loam, 15 to 30 percent slopes (Sp).—This soil occupies hilly areas and small canyons adjacent to Puget Sound in association with other Sinclair soils. It differs from Sinclair shotty loam, 5 to 15 percent slopes, in that it varies more in depth to the till and in the degree of cementation of till. In the canyons and on the steeper slopes, small areas of Kitsap, Alderwood, or Harstine soils are included.

Under natural conditions, the soil absorbs moisture readily and runoff is slight. Erosion would be severe if large areas were cleared.

Use and suitability.—Nearly all this soil is in forest, but a few tracts are farmed along with Sinclair shotty loam, 5 to 15 percent slopes. Trees grow well and respond to management.

This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

Sinclair shotty clay loam, 0 to 5 percent slopes (Sn).—This soil is in the central part of Squaxin Island where the elevation is less than 25 feet. On the surface there is an inch of organic matter. The mineral surface soil is granular and friable, light brownish-gray (dark brownish-gray when moist) shotty clay loam or silty clay loam. Under this is yellowish-gray, firm, shotty clay loam faintly mottled with yellowish brown. The color grades to light gray with depth, and just above the till the yellowish-brown mottling becomes more pronounced. The depth to the cemented underlying till ranges from 22 to 30 inches.

This soil is closely associated with Kitsap silty clay loam, 5 to 15 percent slopes, and resembles it in some characteristics. The finer texture of this soil undoubtedly results from some admixture of lake-laid sediments.

Use and suitability.—None of this soil is in cultivation. A few semi-cleared areas are used for pasture and grazing. Management practices are similar to those used for Sinclair shotty loam, 5 to 15 percent slopes.

This soil is in capability subclass IVw and in site classes 3 and 4 for Douglas-fir.

SKOKOMISH SERIES

The Skokomish series consists of imperfectly drained, gray-brown soils on bottom lands. They are developing in sediments derived from igneous, sedimentary, and metamorphosed rock of the Olympic Mountains. Rainfall is 60 to 90 inches a year. The vegetation is a very dense stand of alder, maple, vine maple, ash, and cedar.

The soils are wet most of the time. Except in the driest parts of the year, the water table is within 16 to 42 inches of the surface.

Skokomish soils occupy flood plains of the Skokomish River and are closely associated with the Dungeness soils. Soils of both series have developed from similar parent material. Skokomish soils are intermediate in drainage between the Dungeness and the Puget soils.

Skokomish silt loam, 0 to 3 percent slopes (Sr).

Nearly all this soil occurs in the Skokomish River Valley. The surface soil, about 8 inches thick, is friable and weak granular, dark grayish-brown to grayish-brown silt loam. It is slightly acid to medium acid and high in organic matter. In places, mottles of yellow and brown occur near the surface. The subsurface layer, between depths of 8 and 15 inches, is friable, grayish-brown silt loam having a weak, fine, subangular blocky structure and containing slightly more mottles than the surface soil. Below depths of 15 to 18 inches is the friable, grayish-brown silt loam subsoil, which is mottled with yellowish brown and has a weak, subangular blocky structure. Below a depth of 36 inches, the mottles are more pronounced, and, at varying levels below 36 inches, stratified silt, clay, and fine sand commonly occur. Lenses of gravel occasionally are at lower depths.

The soil has a higher water table and occupies a lower position than the associated Dungeness soils. Drainage is necessary for crops.

Use and suitability.—This is a productive and fertile soil, but its use is limited mostly to pasture and hay unless it is adequately drained (fig. 5). Pasture is better



Figure 5.—Skokomish silt loam, 0 to 3 percent slopes. In background is Hoodspur gravelly sandy loam, 5 to 15 percent slopes.

in summer on this soil than on adjacent soils. In winter and often late in spring, the soil is too wet for anything but permanent pasture. Proper drainage allows this soil to be used for about the same crops as described for Dungeness soils. Skokomish silt loam, 0 to 3 percent slopes, is in capability subclass IIw, and it is good for fir, cedar, hemlock, and deciduous trees.

SOL DUC SERIES

The Sol Duc series consists of well-drained to somewhat excessively drained, brown or grayish-brown gravelly soils on low terraces. They have developed in gravel washed from the southern slopes of the Olympic Mountains that, to some extent, has been mixed with continental glacial gravel. The rainfall is 70 to 100 inches a year. The vegetation is a dense forest.

Sol Duc soils are similar to the Le Bar soils in position and age but differ in containing more gravel. Sol Duc

soils are the somewhat excessively drained associates of the poorly drained Deckerville soils.

Sol Due gravelly loam, 0 to 5 percent slopes (Ss).—This soil is in the southwestern part of the county. The surface layer is a very acid, thin mat of needles, leaves, and twigs. The surface mineral soil is friable and granular, brown or grayish-brown gravelly loam, 3 to 5 inches thick. It is very strongly acid and moderately high in organic matter. This is underlain by a friable, brown or yellowish-brown gravelly loam that contains much less organic matter and is less strongly acid than the surface soil. Below depths of 12 to 15 inches, there is a light yellowish-brown gravelly loam or gravelly sandy loam subsoil that contains more gravel with increase in depth. Below depths of 30 to 35 inches, the subsoil rests on a fairly loose mixture of gravel, sand, and a small amount of fine material. The sand and gravel are stained with yellow, rust color, and dark manganese and are coated with fine material. The gravel is rounded to angular and originated from acid and basic igneous rock, sandstone, and shale.

The soil normally has a low capacity to hold available moisture and is too droughty for uses other than forestry. High rainfall and the hazards of frost restrict the agricultural value of this soil.

Use and suitability.—Nearly all this soil is in second-growth forest consisting mainly of Douglas fir, which restocks well on this soil. Sol Due gravelly loam, 0 to 5 percent slopes, is better for Douglas fir than the nearby Grove soils. Where this Sol Due soil joins with the related Le Bar soils, its capacity to hold available moisture is better and the soil can be used for hay, grain, and pasture.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Sol Due gravelly loam, 5 to 15 percent slopes (St).—This soil is associated with Sol Due gravelly loam, 0 to 5 percent slopes. It differs from that soil mainly in having stronger slopes.

Use and suitability.—This soil is too droughty to be farmed successfully. Use and suitability are the same as for Sol Due gravelly loam, 0 to 5 percent slopes.

This soil is in capability subclass IVs and in site classes 3 and 4 for Douglas-fir.

Sol Due gravelly sandy loam, 0 to 5 percent slopes (Su).—This soil differs from Sol Due gravelly loam, 0 to 5 percent slopes, in texture of surface soil and subsoil. It is also slightly more droughty and has a lower capacity to hold available moisture. The soil is droughty and low in fertility.

Use and suitability.—Nearly all of this soil is in forests of various densities and ages. Forestry is its best use. This soil is in capability subclass VIIs and in site classes 3 and 4 for Douglas-fir.

STIMSON SERIES

The Stimson series consists of poorly drained, gray soils in upland depressions. The surface soil is strongly acid. They have developed from mixed old terrace material. Rainfall is 70 to 100 inches a year. The vegetation is alder, maple, willow, spruce, and cedar. Semi-cleared areas quickly grow up to wild rose, spirea, sedges, and water-tolerant grasses. Stimson soils occur in the

southwestern part of the county in association with the Hoquiam soils.

Stimson silt loam, 0 to 2 percent slopes (Sv).—This soil is in small, scattered areas. The surface soil is 4 to 6 inches of friable and moderately granular, gray or dark grayish-brown silt loam. It is high in organic matter and strongly acid. This layer is underlain by firm, light-gray silty clay loam, which continues to depths of 12 to 14 inches and is prominently mottled with reddish yellow and yellowish brown. The light-gray layer has a weak, blocky structure. The subsoil, next lower in the profile, extends from a depth of 12 inches to about 30 inches. It is firm, moderately plastic, light brownish-gray silty clay, which has a moderately blocky structure and is prominently mottled with yellow, red, and brown. Below this, the material is light-gray, massive and firm silty clay. At various depths below 48 inches, the light-gray silty clay grades to a multicolored, disintegrating matrix of clay and gravel similar to the parent material of the Hoquiam soils.

Lenses of light-gray diatomaceous earth, 1 to 3 inches thick, are occasionally found in the upper part of the profile. All soil layers are strongly acid.

Use and suitability.—A few areas have been cleared or partly cleared for pasture. Drainage is necessary before pastures can be maintained. Management is similar to that described for the Bellingham soils. This soil is in capability subclass IVw; it is fair for mixed forests.

TACOMA SERIES

The Tacoma series consists of very poorly drained peat soils. It is in low, flat, coastal areas, and it developed from partly decomposed salt-tolerant grasses, sedges, and other plants that have been mixed with sediment deposited by rivers and tides. It is almost entirely reclaimed tidal marsh that is protected by dikes. The water table is high throughout the year.

Tacoma peat, 0 to 2 percent slopes (Ta).—This soil consists of 16 to 24 inches of matted, raw, fibrous, brown peat underlain by loose beach sand and gravel. Occasional floods have broken dikes, and fine river sediment has been deposited over the peat in some areas. The sediment has, subsequently, become mixed with the upper part of peat. Gravel bars and ridges of very shallow peat are fairly common. Near the channels of rivers and sloughs the peat is, in many places, underlain by mottled and iron-stained silt and clay. Iron-stained lenses of silt may occur any place in the profile. This soil is medium acid but may contain considerable salt.

Use and suitability.—When adequately diked and drained, properly managed Tacoma peat is fairly good for hay, grain, and pasture. This soil is in capability subclass IIIw.

TANWAX SERIES

The Tanwax series consists of brown peat derived from sedimentary materials that decompose fairly completely into highly colloidal, smooth, peaty material having a greasy feel. The bogs are saturated throughout the year, but they dry enough for spirea to become established and contribute considerable plant residue to the upper part of the peat. The peat gives up moisture slowly, but once the peat has dried, the resulting hard, persistent lumps are difficult to saturate again.

Tanwax peat, 0 to 2 percent slopes (Tb).—This soil occurs in small isolated areas, generally in association with poor agricultural soils. The surface soil, 10 to 16 inches thick, consists of a very dark grayish-brown mixture of woody spirea fragments and sedimentary peat. It is strongly acid and friable. This grades to dark-brown or dark grayish-brown, smooth, greasy-feeling sedimentary peat containing little fibrous material. At depths of 24 to 30 inches, it is nearly black and highly colloidal. The substratum, at various levels below a depth of 30 inches, is compact gravel or gravelly till.

In many areas, lenses of gray, chalklike diatomaceous earth, 1 to 4 inches thick, occur at various depths. Usually they are in the upper part of the profile. They are intermittent and sporadic. The lenses of diatomaceous earth occur more commonly in Tanwax peat than in any of the other peats.

Tanwax peat is strongly acid, difficult to drain, and hard to work if too well drained.

Use and suitability.—Practically none of this soil is farmed. It is of moderately low agricultural value (capability subclass IVw).

Tanwax peat, shallow over gravel, 0 to 2 percent slopes (Tc).—This soil differs from Tanwax peat, 0 to 2 percent slopes, in that its depth to underlying gravel is less than 30 inches. Normally, the gravel is 16 to 24 inches from the surface.

Use and suitability.—The uses of this soil, and its suitability, are the same as for Tanwax peat, 0 to 2 percent slopes. This soil is in capability subclass IVw.

TEBO SERIES

The Tebo series consists of reddish-brown, well-drained upland soils. These soils have developed in place from weathered basaltic or andesitic rock. In addition, glacial deposits have influenced the upper part of the profile. The rainfall is 60 to 100 inches per year. The native vegetation is a dense and luxuriant forest, mainly Douglas-fir. Tebo soils are mainly in the southern part of the county, on the foot slopes or in the occasional smoother places in hilly and mountainous terrain of the Black Hills.

The Tebo series is most nearly similar to the Olympic series in other areas, but it differs in that its development has been influenced by glacial material and it occurs in an area of higher rainfall. The Tebo soils differ from the associated Astoria and Hoquiam soils in parent materials.

Tebo loam, 5 to 15 percent slopes (Tg).—This soil is of limited extent. Most of it lies at the bases of and on lower slopes of hills and mountains. A 1- or 2-inch mat of forest litter is underlain by a 3- or 4-inch surface soil of reddish-brown, granular and friable loam. Many small roots; numerous small, reddish shot; and occasional angular fragments of basalt, gravel, and stones are in the surface soil. This layer is underlain by 6 to 10 inches of friable and granular material that is slightly lighter colored and slightly finer in texture than the layer above. Below depths of 10 to 12 inches, the subsoil is firm, yellowish-red, strong blocky clay loam containing a few shot. Beginning at depths of 18 to 24 inches and continuing to depths of 36 to 50 inches, the subsoil is a strong-brown, firm clay loam mixed with irregular basaltic stones and disintegrating basalt. The subsoil

grades to a substratum of highly weathered, firm, massive stony clay loam that is stained with yellow and purple. The substratum grades to bedrock at depths ranging from 3 to 6 feet.

Variations in slope are accompanied by slight variations in soil color. The well-aerated areas on upper slopes are redder than those on lower, more gentle slopes.

The soil is strongly acid throughout. Surface drainage is well established; internal drainage is medium. The moisture-holding capacity is good.

Use and suitability.—Except for the very few cleared areas, most of this soil has been logged and is now in second-growth timber. Douglas-fir restocks well and makes good growth.

The cultivated acreage is small because of inaccessibility and the high cost of clearing. Cleared areas are fairly productive. Fertility is low, but it can be maintained if management is good. The soil needs additional organic matter and nitrogen; phosphate fertilizers are also beneficial.

This soil is in capability subclass IVs and in site classes 1 and 2 for Douglas-fir.

Tebo loam, 15 to 30 percent slopes (Tn).—This soil occupies the fairly inaccessible, hilly areas on the lower mountains. It occurs mainly in the extreme southern part of the county. Slopes make it unsuitable for cultivation. The soil differs from Tebo loam, 5 to 15 percent slopes, in having a greater range in depth to bedrock and in content of glacial gravel and stone. In a few areas, where the influence of Astoria and Hoquiam soil materials is evident, the profile is usually deeper, more finely textured, and less brightly colored.

Use and suitability.—The soil is suitable for forestry or for light grazing. It is in site classes 1 and 2 for Douglas-fir and in capability subclass VIe.

Tebo gravelly loam, 5 to 15 percent slopes (Td).—This soil differs from the closely associated Tebo loam, 5 to 15 percent slopes, in that it contains much more glacial and basaltic gravel and stone and is shallower to parent rock. Disintegrating basalt may be within 18 to 24 inches of the surface, and bedrock, at depths of 3 to 5 feet. Depth to bedrock and the amount of angular gravel and stone vary within short distances.

Use and suitability.—Only a few areas have been cleared. The rest is in second-growth Douglas-fir. The use of this soil is similar to that of Tebo loam, 5 to 15 percent slopes. Its best use is forestry. Most of the acreage is adjacent to steeper soils where forestry is the only safe use.

This soil is in capability subclass IVs and in site classes 1 and 2 for Douglas-fir.

Tebo gravelly loam, 15 to 30 percent slopes (Te).—This soil occupies most of the lower hilly slopes that are not mapped as Rough mountainous land, Tebo soil material. It differs from Tebo gravelly loam, 5 to 15 percent slopes, in that it is shallower and stonier in many places. Runoff and erosion would be hazardous if this soil were cleared. Vegetation should not be removed, as it prevents erosion.

Use and suitability.—This soil is all in forests consisting mainly of Douglas-fir and hemlock. It is in site classes 1 and 2 for Douglas-fir and in capability subclass VIe.

Tebo gravelly loam, 30 to 45 percent slopes (Tf).—This soil is on steep slopes and in gullies and canyons. It differs from Tebo gravelly loam, 5 to 15 percent slopes, in being shallower, stonier, and more variable. Some areas consist almost entirely of exposed rock, and, over much of the area, bedrock is covered by only a few inches of soil.

Use and suitability.—This soil is not used for farming. Because of topography, it is suited only to forestry. It is not a desirable forestry soil. It produces some timber, but in many places the timber is difficult to harvest. This soil is in capability subclass VIe and in site classes 1 and 2 for Douglas-fir.

TEBO-ASTORIA COMPLEX

This complex occupies several small areas near the Grays Harbor County line. Astoria and Tebo soil materials are so intermixed that a blending of the two materials has caused some of the soil to have characteristics that are different from those of the Astoria or the Tebo series.

Tebo-Astoria complex, 5 to 15 percent slopes (Tk).—In most places the surface soil reaches to a depth of about 12 inches and is a dark-brown, granular, friable silt loam. Below 12 inches the soil contains varying amounts of disintegrating sandstone, shale, or basalt parent rock, and the color changes to pale brown or yellowish brown.

The soil is deep and, in most places, overlies soft sandstone, shale, or basalt parent rock. A few rounded pebbles in the soil indicate that glacial activity reached these areas.

Use and suitability.—This complex is not farmed. Clearing would be difficult and expensive. The areas are almost inaccessible and heavily wooded. Logged areas are covered by a dense growth of alder and maple. They are slow to restock to Douglas-fir, but the fir grows rapidly once it is established.

This soil is in capability subclass IVs and in site class 2 for Douglas-fir.

Tebo-Astoria complex, 15 to 30 percent slopes (Tm).—This complex differs from Tebo-Astoria complex, 5 to 15 percent slopes, mainly in slopes.

Use and suitability.—Because of slope, this complex is suitable only for forestry. Douglas-fir is slow to restock because alder and maple readily take over logged areas. Once the Douglas-fir is established, it grows rapidly.

This soil is in capability subclass VIe and in site class 2 for Douglas-fir.

TIDAL MARSH

Tidal marsh is a miscellaneous land type in nearly level areas reached by high tides.

Tidal marsh, 0 to 2 percent slopes (Tr).—This land type is reached by salt water during high tides. It is composed of various kinds of silt, but it is mainly medium- and fine-textured material mixed with fibrous peat. Some areas contain very fine sand. The sediments contain excessive soluble salt. The vegetation is salt-tolerant grasses, sedges, and other low-grade plants.

Use and suitability.—In its natural state, this land type has no agricultural value. When drained and diked, it is suitable for pasture, hay, and grains. It is in capability class VIII.

WADELL SERIES

The Wadell series consists of brown and reddish-brown, well-drained soils on sloping alluvial fans and low terraces. They are developing in alluvium derived from basic igneous rocks. Streams carried this material from the mountainous area of Tebo soils. The rainfall is 60 to 80 inches a year. The vegetation is a dense coniferous forest with the understory that commonly occurs in forests of Mason County.

Wadell soils occur along fringes of the Black Hills in the southern part of the county.

Wadell gravelly loam, 0 to 5 percent slopes (Wc).—This soil occurs as small acreages in the major valleys in the southern part of the county. The surface layer is organic material, 1 to 2 inches thick. The mineral surface soil is granular and friable, medium acid, reddish-brown gravelly loam, 6 to 10 inches thick. Where the soil has not been disturbed, the upper 2 to 3 inches is usually slightly darker and higher in organic matter. The gravel is angular and largely of basalt, but glacial gravel is occasionally found. Below the surface soil is the subsoil, which reaches to depths of 24 to 28 inches. The subsoil is friable, slightly gravelly loam to gravelly clay loam of weak, subangular blocky structure. It is redder than the surface soil and contains more gravel. The amount of gravel in both layers varies within short distances. Neither layer contains much shot. The substratum normally is loose, brown to reddish-brown, very gravelly sandy loam mottled with yellow and reddish brown. It contains many angular basalt stones, gravel, and cobbles.

Surface drainage is good, internal drainage is medium, and the capacity to hold available moisture is good.

Use and suitability.—The soil is productive, but very few acres have been cleared for agriculture. The cleared land is used for pasture, grains, and other crops. Yields are good, but drying of the soil in summer damages crops. Yields of crops, particularly pastures, are improved through irrigation. Cropping soon depletes nitrogen and organic matter, but they can be replaced by use of commercial fertilizer and barnyard manure. Applying phosphate and nitrogen fertilizers and using green-manure crops in rotations will improve most crops.

Most of the soil is in second-growth forest; production of Douglas-fir timber is good. The soil is in capability subclass IIIs and in site class 3 for Douglas-fir.

Wadell gravelly loam, 5 to 10 percent slopes (Wb).—This soil has more rapid surface runoff than Wadell gravelly loam, 0 to 5 percent slopes. In addition, it tends to dry earlier. A few areas are included that have slopes of as much as 15 percent.

Use and suitability.—Use and suitability are the same as for Wadell gravelly loam, 0 to 5 percent slopes. This soil is in capability subclass IVs and in site class 3 for Douglas-fir.

Wadell loam, 0 to 5 percent slopes (Wc).—This soil differs from Wadell gravelly loam, 0 to 5 percent slopes, in texture of surface soil. It has little or no gravel in the upper 8 to 12 inches.

Use and suitability.—Use and suitability are the same as for Wadell gravelly loam, 0 to 5 percent slopes. This soil is in capability subclass IIIs and in site class 3 for Douglas-fir.

WAPATO SERIES

The Wapato series consists of poorly drained, grayish-brown, recently developed alluvial soils. They are forming in alluvium consisting mainly of sandstone, shale, and basalt material. The vegetation consists of a dense forest of deciduous trees and cedar with a dense undercover of spirea, sedges, willow, and other water-tolerant shrubs and grasses. Wapato soils are wet most of the year, and they are covered by water in winter and early in spring.

Wapato soils differ from the Skokomish, Puget, and Nuby soils mainly in origin of parent material. In addition, they have strong granulation of surface soil and more finely textured and more mottled subsoil.

Wapato silt loam, 0 to 3 percent slopes (Wd).—This soil is in the southern and southwestern parts of the county. The surface soil is a friable and moderately granular, dark grayish-brown, heavy silt loam, 6 to 8 inches thick. It is faintly mottled with yellow and brown to the top. The upper subsoil is a light brownish-gray silty clay mottled with brown, yellowish brown, and reddish yellow. It is firm, has a strong, subangular blocky structure, and is underlain by light brownish-gray silty clay that reaches to a depth of 40 inches. This layer is prominently mottled with yellowish red. It is less blocky than the upper subsoil and is firm and plastic, but there is little to no compaction. Roots penetrate readily. The substratum is mottled, stratified fine sand, silt, and clay. Internal drainage is slow and surface drainage is restricted.

The upper 6 to 8 inches of soil may be highly mottled or free of mottling. In addition, the texture of that layer may range from fine silt loam to coarse silty clay loam. Included with this soil are about 60 acres that are more swampy than the rest.

Drainage is often a problem because the soil is in low positions on alluvial bottom lands. In places where surface water readily runs off, the slow internal drainage is less serious and may even benefit late-summer hay, grains, and pasture.

Use and suitability.—This soil is fertile and productive. If adequately drained, it is highly productive. However, because of the drainage problem, clearing costs, and isolation, only a small area of this soil is farmed. It is used in combination with other soils for grain, hay, and pasture. Yields are somewhat like those from Maytown silt loam, 0 to 3 percent slopes, but vary, depending on weather and the adequacy of drainage. Many areas of this soil are still in natural condition, and others have been partly cleared for pasture.

This soil is in capability subclass IIIw, and it is good for redcedar, red alder, and Oregon-maple.

Wapato silty clay loam, 0 to 3 percent slopes (We).—This soil differs from Wapato silt loam, 0 to 3 percent slopes, in texture of surface soil. It occupies slightly lower positions than the associated Wapato silt loam. Consequently, surface drainage is somewhat slower, and water stands on the surface for longer periods.

Use and suitability.—Very little, if any, of this soil is in cultivation. It is in trees or has been partly cleared. Use and suitability are the same as described for Wapato silt loam, 0 to 3 percent slopes.

This soil is in capability subclass IIIw, and it is good for redcedar, red alder, and Oregon-maple.

Use, Productivity, and Capability Groups of Soils

In this section, the use and management of Mason County soils are discussed. Their productivity for crops and their suitability for forestry are shown. In addition, the soils are grouped according to capability classes and subclasses.

Use of Soils

Most soils in Mason County are in forest. Extensive areas of good agricultural soils do not occur. The high cost of clearing, the difficulty of obtaining satisfactory yields the first several years, and distance to markets prevent rapid expansion of agriculture.

The many soils in Mason County differ to some extent in fertility, crop suitability, and management. At the time this survey was completed, specific information on soil management or fertilizer requirements had not been worked out for the individual soils of the county. Information obtained from experiments on similar soils in other counties is used as the basis for suggestions on management.

As a rule, the upland soils are medium to strongly acid, strongly leached of plant nutrients, and low in organic matter and nitrogen. The carbon-nitrogen ratio of newly cleared soil is wide, and only small amounts of nitrogen are made available for crops. Cropping the soil over a period of years tends to increase organic matter and to narrow the carbon-nitrogen ratio, thus making the soil more suitable for crops (21).

The well-drained alluvial soils are less acid, less strongly leached, and naturally more fertile than upland soils. However, organic matter and nitrogen are usually low in these soils. The poorly drained soils contain more organic matter than the better drained soils, and they are usually more fertile. If cropped, they soon need amendments to maintain their productivity.

The main requirement of nearly all soils is additional organic matter and nitrogen. These can be supplied and maintained through the use of legumes in rotations, use of green-manure crops, and the application of all available barnyard manure. The use of a legume every third year in the rotation benefits any cropping system used in this area. Phosphate fertilizer applied with manure, or when green-manure crops are plowed under, is also beneficial. In many cases, nitrate fertilizer would benefit crops by furnishing nitrogen for the decomposition of organic matter. Responses to potash fertilizer have been obtained—particularly in the peat soils—but they are less frequent than responses obtained from nitrogen or phosphate.

Most soils have enough lime for crops. To neutralize the soil acidity would require, in most cases, large quantities of lime; and, for most crops, this is neither necessary nor practical. Alfalfa and clover are the crops most likely to benefit from lime. It is well to remember that, though other plant nutrients may be needed, nitrogen, in most cases, is the limiting plant nutrient. Unless enough of this element is available, other fertilizers may not improve yields of crops.

More than three-fourths of the land in crops is used for hay and pasture. Poor stands and low yields are often the result of poor seeding, poor plant mixtures, low fertility, or improper maintenance of the stands once they are established. Seedbeds for hay and pasture should be firm and thoroughly mixed in the plowed layer. A loose, cloddy seedbed is likely to result in a poor and patchy stand. The seeding should be made early in spring. If grass and clover seed are broadcast early in spring, the seed will be covered enough through the action of rain; otherwise, it must be covered through lightly harrowing the soil.

Pastures are better if a well-fertilized row crop was on the soil before it was seeded to pasture. Previous use for row crops helps improve soil tilth, the control of weeds, and the amount of plant nutrients available for the pasture and hay.

If sufficient moisture is available, a companion crop, seeded at one-half to two-thirds the normal rate, may be planted with a mixture of grass and clover. Canning or forage peas are good companion crops because they can be harvested early. Barley or oats are often used because they ripen early and are good nurse crops. Barley uses less moisture and makes less shade than the other grains. The companion crops must be harvested early to avoid the use of too much moisture and the risk of interfering with the growth of the permanent pasture plants. Grass-and-clover mixtures usually make a crop of hay the first year if a nurse crop is not grown.

The curing of hay is difficult in the climate of Mason County. Hay of poor quality is often obtained because of late cutting or damage from weather. Most farmers wait too long before cutting hay. Although hay cut late in May or June may be severely damaged by weather, the loss of quality is often no more severe than that resulting from overmaturity of hay plants. Hay should be cut early to have the advantage of good weather. The advantage of early cutting is that it removes the crop before dry weather, and growth is improved for pasture or for the second crop of hay.

To avoid damage to the stand, pastures planted in spring should be grazed very lightly for the first time after the start of fall rain. Established pastures should be divided into three or more parts and grazed in rotation. Overgrazing weakens the stand, lowers production, and encourages the growth of weeds. The fertility of soils used for hay and pasture can be maintained by applying fertilizer in fall or winter. Six to eight tons of barnyard manure per acre, applied at intervals, is a good topdressing for pastures. Manure can be supplemented with superphosphate the first 2 or 3 years, and then phosphorus should be applied alone whenever the condition of the plants warrants it. Harrowing every year scatters fertilizer and droppings and reduces molehills.

Newly cleared soil should be in green-manure crops for at least 1 or 2 years before permanent vegetation is seeded. Rosen rye or winter wheat seeded with hairy vetch or common vetch is a mixture to seed in fall as a green-manure crop. Spring oats or spring wheat seeded with field peas is good as a spring-planted, green-manure crop. These crops grow better on newly cleared land if fertilizer is used. Besides improving the green-manure

crop, fertilizer furnishes nutrients to the crops that follow. Nitrate nitrogen applied at seeding time promotes rapid early growth. Phosphate with nitrogen or with barnyard manure is also recommended (5). Green-manure crops increase the amount of organic matter and improve the tilth and fertility of newly cleared areas. The crop also helps control bracken fern, which is a damaging pest in this area.

Table 5 shows the uses and management of the soil series in Mason County; the series are grouped according to origin and topographic position.

Productivity of Soils

Table 6 gives estimated average acre yields of important crops for the soils of Mason County. The yields are averages for a period of years, and the management needed to obtain them is that ordinarily practiced in the county. The table also contains estimates on the suitability of the soils for forestry.

The estimates are based on the assumption that the soils have been adequately drained, that the fields have been well cleared, and that the soils are not irrigated. It is also assumed that available manure is applied and that small quantities of commercial fertilizer are used. Crop rotations, however, are not used. Systematic rotation of crops is not practiced, because so much of the land is used for pasture and hay.

Under improved management, yields might be as much as double those shown in table 6. Such management would include supplemental irrigation, planting better varieties of crops, and applying fertilizer in proper amount and balance.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for crops, grazing, forestry, and wildlife. It is a practical grouping based on the needs and limitations of the soils, the risks of damage to them, and their response to management. There are three levels above the soil mapping unit in this grouping. They are the capability unit, subclass, and class.

The capability unit, which can also be called a management group of soils, is the lowest level of capability grouping. A capability unit is made up of soils similar in kind of management they need, in risk of damage, and in general suitability for use.

The next broader grouping, the subclass, is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means that wetness and the frequency of overflow make the soil unsuited to cultivation; "s" means that sandiness, shallowness, or a very slowly permeable subsoil make the soil too droughty for any but native plants adapted to the condition. In some parts of the country there is another subclass, "c", for soils that are limited chiefly by a climate that is too dry or too cold.

The broadest grouping, the land capability class, is identified by Roman numerals. All the soils in one class have limitations and management problems of about the

TABLE 5.—*Use and management of the soil series according to topographic position and origin*

[Data are for slopes up to 15 percent. Steeper slopes should be in forests or in other natural condition]

Topographic position and origin	Soil series	Present uses	Suitable uses	Factors limiting agricultural use	Management
Upland: Nonglacial	Astoria Hoquem. Tebo.	Forestry, pasture and hay. Forestry, pasture and hay. Forestry, pasture and hay.	Forestry and pasture Forestry and pasture Forestry	Clearing costs, inaccessibility, and high rainfall.	Reforest where needed, maintain organic matter.
Glacial moraine	Alderwood Delphi Hartne	Forestry; hay, pasture, grains, berries, and grapes. Forestry; hay, pasture, grains, berries, and grapes. Forestry; hay, pasture, grains, berries, and grapes.	Forestry; berries, grapes, hay, and pasture. Forestry; berries, grapes, hay, and pasture. Forestry; berries, grapes, hay, and pasture.	Inaccessibility, clearing costs, low fertility, and lack of summer moisture.	Maintain organic matter; use green manure crops.
Outwash plains and eskers, gravelly drift.	Goodsport Shelton Sirclair Carsairs Everett Grove	Forestry, hay and pasture. Forestry; hay, pasture, grains, berries, and grapes. Grazing Forestry; feed crops and vegetables for home use. Forestry; feed crops and vegetables for home use.	Forestry; berries, grapes, hay, and pasture. Forestry, berries, grapes, hay, and pasture. Grazing Forestry Forestry	Droughtiness and low fertility.	Prevent overgrazing
Outwash plains, sandy drift.	Indiana Lystair	Forestry; feed crops and vegetables for home use. Forestry; feed crops and vegetables for home use.	Forestry Forestry	Droughtiness and low fertility.	Reforest where needed and girdle lodgepole pine.
Glacial lake sediment.	Cloquallum Kitsap Nordby Saxon	Small farms, berries, fruits, vegetables, and hay. Small farms; berries, fruits, vegetables, and hay. Forestry Hay, grain, pasture, and vegetables.	Feed crops and vegetables for home use; pasture, berries, and fruits. Feed crops and vegetables for home use; pasture, berries, and fruits. Feed crops and vegetables for home use; pasture, berries, and fruits. Feed crops and vegetables for home use; pasture, berries, and fruits.	Cost of clearing Cost of clearing Forestry Cost of clearing	Maintain organic matter; use green manure crops and legumes in rotation.

Terraces and alluvial fans	Belle-	Forestry; hay and pasture.	Hay and pasture	Remoteness and small areas.
	Le Bar	Forestry; hay and pasture.	Hay and pasture	Remoteness and small areas.
	Nasel	Hay, pasture, and small grains.	Hay, pasture, and small grains.	Lack of fertility
	Sol Duc	Forestry, grazing and hay.	Forestry, grazing, hay, and pasture.	Clearing costs, droughtiness, and frost.
	Waddell	Forestry; pasture and hay	Forestry; grazing, hay, and pasture.	Clearing costs
	Bellingham	Hay, pasture, and small grains.	Hay, pasture, and grains.	Drainage, clearing costs, and small areas.
	Deckerville	Hay, pasture, grains, and grazing.	Pasture, hay, and small grains.	Drainage, small areas, and frost.
	Edmonds	Woodland; pasture and hay.	Hay, pasture, and grains.	Drainage, clearing costs, and small areas.
	Koch	Forestry; pasture and grazing.	Woodland, pasture and hay.	Drainage, small areas, and frost.
	McKenna	Woodland, pasture and grazing	Woodland, pasture and hay.	Drainage and small areas.
Depressions: Upland (mineral soils).	Norma	Pasture and woodland	Hay, pasture, and grains.	Drainage, clearing costs, and small areas.
	Stimson	Forestry	Woodland; pasture and hay.	Drainage, small areas, and frost.
	McMurray	Mostly swamp; some hay and pasture.	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage
	Mukulcoo	Mostly swamp; some hay and pasture.	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage
	Oreas	Swamp	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage
	Semiahmoo	Mostly swamp; some hay and pasture.	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage
	Tacoma	Pasture	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage
	Tanwaix	Swamp	When drained, good for hay, pasture, and shallow-rooted crops.	Drainage and lack of fertility
	Belfast	Woodland, hay, pasture, and grains.	Hay, grains, pasture, and berries.	Small remote areas
	Dungeness	Hay, pasture, grains, and berries.	Hay, grains, pasture, and berries.	Clearing costs
Bottom land:	Fld.	Pasture and grains	Hay, grains, pasture, and berries.	None
	Juno	Pasture and grazing	Sod-forming crops	Droughtiness
	Maytown	Hay, pasture, and grains	Hay, grains, pasture, and berries.	Remoteness
	Pilchuck	Woodland pasture and grazing	Sod-forming crops	Droughtiness
	Skokomish	Pasture and hay	Pasture, hay, and grains.	Clearing costs and drainage
				See footnotes at end of table.

TABLE 5.—*Use and management of the soil series according to topographic position and origin*—Continued

Topographic position and origin	Soil series	Present uses	Suitable uses	Factors limiting agricultural use	Management
Bottom land—Con. Alluvium, poorly drained.	Nuby	Woodland, pasture and hay Woodland; hay, pas- ture, and grains.	Hay, pasture, and grains Hay, pasture, and grains.	Small remote areas and drainage Drainage	Artificial drainage, use adapted pas- ture and hay mix- tures.
	Puget			Drainage	
	Wapato	Forestry; pasture, hay, and grains.	Hay, pasture, and grains.		

¹ For specific quantities, see the county agent, or contact the State Agricultural Experiment Station.

TABLE 6.—*Estimated average acre yields of crops under common management from soils of Mason County, Wash., and their*
[Absence of yields indicates crop is seldom, if ever, grown, or the soil is not suited to its production]

Soil ¹	Corn silage	Oats	Wheat	Barley	Oats and legume hay	Mixed grass and clover hay	Alfalfa hay	Pas- ture	Pota- toes	Can- ning peas	Rasp- berries	Black- berries	Sulta- nines	Sulta- nines Dominant
Alderwood gravelly sandy loam, 5 to 15 percent slopes	Bu 28	Bu 16	Bu 20			Tons 1 8	Tons 2 2	Tons 2 8	Tons 2 8	Bu. 110	Tons 1 5	Tons 1 8	Douglas-fir lock.	
Alderwood gravelly sandy loam, 15 to 30 percent slopes.													Douglas-fir lock.	
Alderwood gravelly sandy loam, 30 to 45 percent slopes.													Douglas-fir lock.	
Alderwood gravelly loam, 5 to 15 percent slopes	32	20	25	20	2 0	2 0	3 0	3 0	125	---	1 3	1 5	Douglas-fir lock.	
Astoria silt loam, 15 to 30 percent slopes.	40	20	30	26	2 6	2 6	3 0	3 0	125	---	1 3	1 5	Douglas-fir lock.	
Astoria silt loam, 5 to 15 percent slopes.	37	40	40	4 0	4 0	4 0	4 3	4 3	180	2 6	4 5	4 5	Fir, cedar, and deer.	
Belfast sandy loam, 0 to 3 percent slopes.	9 0	7 5	33	37	4 0	4 0	4 2	4 2	4 5	190	2 8	4 5	Fir, cedar, and deer.	
Belfast silt loam, 0 to 3 percent slopes.	10 0	7 5	35	40	4 0	4 0	3 8	3 8	4 0	170	2 6	4 5	Fir, cedar, and deer.	
Belle silt loam, 0 to 5 percent slopes.	8 5	6 5	30	35	2 8	3 0	4 0	4 0	4 0	---	1 5	3 3	Western red alder, am- maple.	
Bellingham silt loam, 0 to 3 percent slopes.	8 5	7 0	30	35	2 6	3 0	4 0	4 0	4 0	---	1 5	3 3	Western red alder, am- maple.	
Bellingham silty clay loam, 0 to 3 percent slopes.	7 0	6 0	30	2 6	3 0	---	4 0	4 0	4 0	---	1 5	3 3	Western red alder, am- maple.	
Carstairs gravelly loam, 0 to 5 percent slopes	20	12	12	1 0	1 2	---	1 5	80	---	---	1 5	---	Douglas-fir lock. ⁴	
Clouallum silt loam, 5 to 15 percent slopes.	63	28	33	2 8	3 1	3 2	3 5	150	1 6	2 0	2 6	2 6	Douglas-fir lock.	
Clouallum silt loam, 0 to 5 percent slopes.	8 0	65	30	33	3 0	3 2	3 2	3 6	160	1 8	2 0	2 6	Douglas-fir lock.	
Clouallum silt loam, 15 to 30 percent slopes.									2 5	2 5	2 6	---	Douglas-fir lock.	

Clouquallum silty clay loam, 5 to 15 percent slopes.	7.5	63	28	30	2 0	3 3	3 2	3 6	150	1 6	2 0	2 6	Douglas-fir lock.
Clouquallum silt loam, moderately shallow over cemented till, 5 to 15 percent slopes.	7.5	60	30	32	2 8	3 1	2 3	3 5	145	1 5	1 9	2 4	Douglas-fir lock.
Deckerville gravelly loam, 0 to 2 percent slopes.	-	-	-	-	1 6	2 0	-	2 8	-	-	-	-	Western re alder, an trees.
Deckerville silty clay loam, 0 to 2 percent slopes.	6.5	55	20	25	2 2	2 8	-	3 8	-	1 2	-	1 3	Western re alder, an trees.
Deckerville gravelly silty clay loam, 0 to 2 percent slopes.	6.0	52	25	20	2 5	3 0	-	3 8	-	1 2	-	1 2	Western re alder, an trees.
Delphi gravelly loam, 5 to 15 percent slopes.	-	-	-	-	18	2 3	2 8	-	3 5	-	1.2	-	1 2
Delphi gravelly loam, 15 to 30 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir
Dungeness fine sandy loam, 0 to 2 percent slopes.	11.0	85	35	37	4 3	4 0	-	4 5	250	2 8	4 8	4 8	Fir, cedar, and decid.
Dungeness silt loam, 0 to 2 percent slopes.	12.0	90	40	40	4 5	4 3	-	5 0	250	3 0	5 0	5 0	Fir, cedar, and decid.
Dungeness fine sandy loam, shallow, 0 to 2 percent slopes.	10.0	80	30	30	4 0	3 8	-	4 4	200	2 5	4 5	4 5	Fir, cedar, and decid.
Edmonds fine sandy loam, 0 to 2 percent slopes.	8.0	70	-	-	30	3 5	3 6	-	4 1	200	1 3	-	3 3
Edmonds silt loam, 0 to 2 percent slopes.	9.0	75	-	-	30	3 7	3 8	-	4 3	220	1 3	-	3 5
Eld silt loam, 0 to 3 percent slopes.	10.0	80	40	35	3 6	3 8	4 2	4 5	200	2 6	4 2	4 5	Fir, cedar, and decid.
Everett gravelly sandy loam, 5 to 15 percent slopes.	-	-	15	8	12	1 0	8	2 0	70	-	1.1	-	Douglas-fir lock.
Everett gravelly sandy loam, 0 to 5 percent slopes.	-	-	20	10	15	1 2	1 0	2 2	75	-	1 2	-	Douglas-fir lock.
Everett gravelly sandy loam, 5 to 15 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Everett gravelly loamy sand, 15 to 30 percent slopes.	-	-	14	-	10	1 0	-	1 6	1 5	-	-	-	Douglas-fir lock.
Everett gravelly loamy sand, 0 to 5 percent slopes.	-	-	-	14	-	-	-	1 6	1 5	-	-	-	Douglas-fir lock.
Everett gravelly loamy sand, 5 to 15 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove gravelly loamy sand, 15 to 30 percent slopes.	-	-	15	8	12	1 0	1 0	1 0	70	-	1 0	-	Douglas-fir lock.
Grove gravelly loamy sand, 0 to 5 percent slopes.	-	-	-	14	8	10	1 0	1 0	65	-	1 0	-	Douglas-fir lock.
Grove gravelly loamy sand, 5 to 15 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove gravelly sandy loam, 15 to 30 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove gravelly sandy loam, 30 to 45 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove cobbley sandy loam, 0 to 5 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove cobbley sandy loam, 5 to 15 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove cobbley sandy loam, 15 to 30 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.
Grove stony sandy loam, 0 to 5 percent slopes.	-	-	-	-	-	-	-	-	-	-	-	-	Douglas-fir lock.

See footnotes at end of table.

TABLE 6.—*Estimated average acre yields of crops under common management from soils of Mason County, Wash., and forestry. Continued*

Absence of yields indicates crop is seldom, if ever, grown, or the soil is not suited to its production.

Soil 1		Corn silage		Oats	Wheat	Barley	Oats and legume hay	Mixed grass and clover hay	Alfalfa hay	Pasture 2	Potatoes	Canning peas	Raspberries	Blackberries	Suita	
Grove gravelly loam, 0 to 5 percent slopes.	<i>Tons</i>	<i>Bu</i>	20	<i>Bu</i>	10	<i>Bu</i>	15	<i>Tons</i>	1.2	<i>Tons</i>	1.0	<i>Tons</i>	1.2	<i>Tons</i>	Douglas-fir lock.	
Grove gravelly loam, 5 to 15 percent slopes.			18		10		12		1.0		1.2		1.0		Douglas-fir lock.	
Grove gravelly loam, basin phase, 0 to 5 percent slopes.			30		15		18		1.8		2.2		1.35		Fir, cedar and deer	
Grove gravelly loam, basin phase, 0 to 5 percent slopes.			6 0		25		12		1.5		2.0		1.30		Fir, cedar and deer	
Harstine gravelly sandy loam, 5 to 15 percent slopes.			30		16		22		2.0		2.6		100		Douglas-fir lock	
Harstine gravelly sandy loam, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport gravelly sandy loam, 5 to 15 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport gravelly sandy loam, 0 to 5 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport gravelly sandy loam, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport, gravelly sandy loam, 30 to 45 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport, stony sandy loam, 5 to 15 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoodsport stony sandy loam, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoquiam silt loam, 5 to 15 percent slopes.			8 0		70		40		2.8		3.2		4.0		160	1.2
Hoquiam silt loam, 0 to 5 percent slopes.			8 0		70		32		2.9		3.2		4.0		160	1.2
Hoquiam silt loam, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoquiam gravelly silt loam, 5 to 15 percent slopes.			7 5		60		25		3.6		3.0		3.8		150	1.2
Hoquiam gravelly silt loam, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Hoquiam and Astoria silt loams, 5 to 15 percent slopes.			7 5		60		25		3.5		2.6		3.0		150	1.2
Hoquiam and Astoria silt loams, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Indiana loamy sand, 5 to 15 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Indiana loamy sand, 0 to 5 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Indiana loamy sand, 15 to 30 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	
Indiana sandy loam, 0 to 5 percent slopes.			7.5		37		25		25		2.3		2.0		150	2.5
Indiana sandy loam, 0 to 5 percent slopes.			-		-		-		-		-		-		Douglas-fir lock.	

See footnotes at end of table.

TABLE 6.—Estimated average acre yields of crops under common management from soils of Mason County, Wash.,—Continued

Absence of yields indicates crop is seldom, if ever, grown, or the soil is not suited to its production.

Sinclair shatty loam, 5 to 15 percent slopes.	7.5	50	20	25	2.6	2.5	2.8	3.0	150	1.0	2.2	2.2
Sinclair shatty loam, 15 to 30 percent slopes.	7.5	55	25	30	2.5	2.3	2.8	3.3	160	1.2	2.4	2.4
Sinclair shatty clay loam, 0 to 5 percent slopes.	7.5	90	40	35	4.5	4.5	5.0	250	3.0	3.0	5.0	Douglas-fir lock.
Skokomish silt loam, 0 to 3 percent slopes.	12	55	25	28	3.0	3.3	3.5	3.5	150	1.8	3.8	3.0
Sol Duc gravelly loam, 0 to 5 percent slopes.	7.5	50	25	30	3.0	3.0	3.5	3.2	145	1.6	3.5	3.0
Sol Duc gravelly loam, 5 to 15 percent slopes.	6.8	30	15	20	2.2	2.0	2.2	2.5	25	—	—	Douglas-fir lock.
Sol Duc gravelly sandy loam, 0 to 5 percent slopes.	8.5	60	30	35	2.8	3.0	4.0	4.0	25	—	—	Western red alder, and maple.
Stimson silt loam, 0 to 2 percent slopes.	—	—	60	30	3.0	3.0	4.0	4.0	—	—	—	3.0
Tacoma peat, 0 to 2 percent slopes.	—	—	45	—	25	2.2	2.6	3.5	—	—	—	3.5
Tanwax peat, 0 to 2 percent slopes.	—	—	—	—	45	2.2	2.6	3.0	—	—	—	2.5
Tanwax peat, shallow over gravel, 0 to 2 percent slopes.	—	—	—	—	50	25	3.0	3.5	140	2.5	2.5	2.5
Tebo loam, 5 to 15 percent slopes.	—	—	—	—	—	20	2.8	3.5	120	2.5	2.5	Douglas-fir lock.
Tebo loam, 15 to 30 percent slopes.	—	—	—	—	—	45	2.4	2.5	—	—	—	Douglas-fir lock.
Tebo gravelly loam, 5 to 15 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	Douglas-fir lock.
Tebo gravelly loam, 15 to 30 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	Douglas-fir lock.
Tebo gravelly loam, 30 to 45 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	Douglas-fir lock.
Tebo-Astoria complex, 5 to 15 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	Douglas-fir lock.
Tebo-Astoria complex, 15 to 30 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	Douglas-fir lock.
Tidal marsh, 0 to 2 percent slopes.	—	—	—	—	—	—	—	—	—	—	—	(4)
Wadell gravelly loam, 0 to 5 percent slopes.	7.5	60	30	32	3.3	3.5	4.0	150	2.0	2.0	3.2	Douglas-fir lock.
Wadell gravelly loam, 5 to 10 percent slopes.	6.0	55	25	32	3.5	3.5	4.8	150	2.0	2.9	3.2	Douglas-fir lock.
Wadell loam, 0 to 5 percent slopes.	7.5	60	30	32	3.3	3.5	4.5	150	2.0	2.9	3.2	Douglas-fir lock.
Wapato silt loam, 0 to 3 percent slopes.	12	85	35	40	3.8	3.8	4.3	250	3.2	2.5	3.5	Western red alder, and maple.
Wapato silty clay loam, 0 to 3 percent slopes.	10	70	32	35	3.7	3.7	4.1	235	3.0	2.0	3.2	Western red alder, and maple.

¹ Soils not used for agriculture and forestry are omitted: Coastal beach, 0 to 2 percent slopes, Made land, and Gravel pit.

² Air-dry weight of forage cured like hay.

³ Approximate site class as defined in USDA Tech. Bull. 201 (10).

⁴ Nonmarketable timber on prairie or gravel bars in s⁵ Not adapted to general farming, but, if properly managed, cranberries and blueberries.

same degree, but of different kinds, as shown by the sub-class. All the land classes except class I may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops. Except for the organic soils and poorly drained shallow soils, they may also be profitably used for grazing and forestry.

Class I soils (none in Mason County) are those that have the widest range of use and the least risk of damage. They are level, or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty or slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use. These need even more careful management.

In class IV are soils that have greater natural limitations than those in class III, but they can be cultivated for some crops under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops, but they can be used for pasture or range, for woodland, or for wildlife.

Class V soils (none in Mason County) are nearly level and gently sloping but are droughty, wet, low in fertility, or otherwise unsuitable for cultivation.

Class VI soils are not suitable for crops, because they are steep or droughty or otherwise limited, but they give fair yields of forage or forest products. Some soils in class VI can, without damage, be cultivated enough so that fruit trees or forest trees can be set out or pasture crops seeded.

Class VII soils provide only poor to fair yields of forage or forest products and have characteristics that limit them severely for these uses.

In class VIII are soils that have practically no agricultural use. Some of them have value for watersheds, wildlife habitats, or scenery.

The soils of Mason County have been grouped in the following capability classes and subclasses. Symbols that designate subclasses show the dominant kind of factor that limits the capability of the soil. In addition, the soils in classes IV and VI have severe climatic limitations consisting of short growing season and very high rainfall. The soils with climatic limitations are as follows: In subclass IVs, Le Bar, Nordby, Sol Duc, and Tebo soils; subclass IVw, Deckerville and Koch soils; subclass VIIs, Hood sport, Hoquiam, and Sol Due soils; and in subclass VIIe, Astoria, Hood sport, Hoquiam, and Tebo soils.

Class II.—Soils in class II have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIs.—Nearly level or very gently sloping alluvial soils of medium to high fertility and available moisture-holding capacity. In this subclass is:

Maytown silt loam, 0 to 3 percent slopes.

Subclass IIw.—Deep, loamy, slowly permeable soils of bottom lands, and organic soils; highly productive if drained and well managed. In this subclass are:

Dungeness silt loam, 0 to 2 percent slopes.
Dungeness fine sandy loam, 0 to 2 percent slopes.
Semiahmoo muck, 0 to 2 percent slopes.
Skokomish silt loam, 0 to 3 percent slopes.

Class III.—Soils in class III have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIIs.—Nearly level to gently sloping soils with medium fertility and fair to good available moisture-holding capacity. In this subclass are:

Belfast sandy loam, 0 to 3 percent slopes.
Belfast silt loam, 0 to 3 percent slopes.
Belle silt loam, 0 to 5 percent slopes.
Cloquallum silt loam, 0 to 5 percent slopes.
Dungeness fine sandy loam, shallow, 0 to 2 percent slopes.
Eld silt loam, 0 to 3 percent slopes.
Kitsap silt loam, 0 to 5 percent slopes.
Nasel gravelly loam, 0 to 5 percent slopes.
Wadell loam, 0 to 5 percent slopes.
Wadell gravelly loam, 0 to 5 percent slopes.

Subclass IIIw.—Poorly drained soils that have slowly permeable subsoils or substrata, and organic peat soils. In this subclass are:

Edmonds silt loam, 0 to 2 percent slopes.
Edmonds fine sandy loam, 0 to 2 percent slopes.
McMurray peat, 0 to 2 percent slopes.
Mukilteo peat, 0 to 2 percent slopes.
Norma silt loam, 0 to 3 percent slopes.
Norma sandy loam, 0 to 3 percent slopes.
Nuby silt loam, 0 to 3 percent slopes.
Puget silt loam, 0 to 2 percent slopes.
Tacoma peat, 0 to 2 percent slopes.
Wapato silt loam, 0 to 3 percent slopes.
Wapato silty clay loam, 0 to 3 percent slopes.

Class IV.—Soils in class IV have very severe limitations that restrict the choice of plants, require very careful cultivation, or both.

Subclass IVs.—Medium to moderately coarse textured soils with low to medium fertility. The soils in this subclass are:

Alderwood gravelly loam, 5 to 15 percent slopes.
Delphi gravelly loam, 5 to 15 percent slopes.
Grove gravelly loam, 0 to 5 percent slopes.
Grove gravelly loam, 5 to 15 percent slopes.
Grove gravelly loam, basin phase, 0 to 5 percent slopes.
Indianola sandy loam, 0 to 5 percent slopes.
Indianola sandy loam, 5 to 15 percent slopes.
Juno loam, 0 to 3 percent slopes.
Juno gravelly sandy loam, 0 to 3 percent slopes.
Juno sandy loam, 0 to 3 percent slopes.
Le Bar silt loam, 0 to 5 percent slopes.
Lystair sandy loam, 0 to 5 percent slopes.
Lystair sandy loam, 5 to 15 percent slopes.
Nordby loam, 0 to 5 percent slopes.
Nordby loam, 5 to 15 percent slopes.
Shelton gravelly loam, 5 to 15 percent slopes.
Shelton gravelly sandy loam, 0 to 5 percent slopes.
Shelton gravelly sandy loam, 5 to 15 percent slopes.
Shelton-Astoria complex, 5 to 15 percent slopes.
Sinclair shotty loam, 5 to 15 percent slopes.
Sol Duc gravelly loam, 0 to 5 percent slopes.
Sol Duc gravelly loam, 5 to 15 percent slopes.
Tebo gravelly loam, 5 to 15 percent slopes.
Tebo loam, 5 to 15 percent slopes.
Tebo-Astoria complex, 5 to 15 percent slopes.
Wadell gravelly loam, 5 to 10 percent slopes.

Subclass IVw.—Poorly drained soils suitable for tillage only part of the time or if carefully managed. Soils in this subclass are:

Bellingham silt loam, 0 to 3 percent slopes
 Bellingham silty clay loam, 0 to 3 percent slopes
 Deckerville gravelly loam, 0 to 2 percent slopes
 Deckerville silt loam, 0 to 2 percent slopes
 Deckerville silty clay loam, 0 to 2 percent slopes
 Deckerville gravelly silty clay loam, 0 to 2 percent slopes
 Kitsap silty clay loam, 0 to 5 percent slopes
 Koch gravelly loam, 0 to 3 percent slopes
 Koch gravelly sandy loam, 0 to 3 percent slopes
 Koch silt loam, 0 to 3 percent slopes
 McKenna gravelly loam, 0 to 3 percent slopes
 McKenna loam, 0 to 3 percent slopes
 McMurray peat, shallow over gravel, 0 to 2 percent slopes.
 Mukilteo peat, shallow over gravel, 0 to 2 percent slopes.
 Semiahmoo muck, shallow, 2 to 10 percent slopes.
 Sinclair shotty clay loam, 0 to 5 percent slopes.
 Stimson silt loam, 0 to 2 percent slopes
 Tanwax peat, 0 to 2 percent slopes
 Tanwax peat, shallow over gravel, 0 to 2 percent slopes.

Subclass IVe.—Medium-textured, sloping, lacustrine soils, highly erodible if not protected. In this subclass are:

Cloquallum silt loam, 5 to 15 percent slopes
 Cloquallum silty clay loam, 5 to 15 percent slopes
 Cloquallum silt loam, moderately shallow over cemented till, 5 to 15 percent slopes.
 Kitsap silt loam, 5 to 15 percent slopes.
 Kitsap silty clay loam, 5 to 15 percent slopes.
 Saxon silt loam, 5 to 15 percent slopes.

Class VI.—Soils in class VI have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIIs.—Coarse and moderately coarse textured, droughty soils, or medium-textured soils of low fertility, occurring in belts of very high rainfall. In this subclass are:

Alderwood gravelly sandy loam, 5 to 15 percent slopes
 Alderwood gravelly sandy loam, 15 to 30 percent slopes
 Carstairs gravelly loam, 0 to 5 percent slopes.
 Everett gravelly loamy sand, 0 to 5 percent slopes
 Everett gravelly loamy sand, 5 to 15 percent slopes.
 Everett gravelly loamy sand, 15 to 30 percent slopes
 Everett gravelly sandy loam, 0 to 5 percent slopes.
 Everett gravelly sandy loam, 5 to 15 percent slopes
 Everett gravelly sandy loam, 15 to 30 percent slopes.
 Grove gravelly sandy loam, 0 to 5 percent slopes.
 Grove gravelly sandy loam, 5 to 15 percent slopes.
 Grove gravelly sandy loam, 15 to 30 percent slopes.
 Grove gravelly sandy loam, basin phase, 0 to 5 percent slopes
 Grove cobbley sandy loam, 0 to 5 percent slopes
 Grove cobbley sandy loam, 5 to 15 percent slopes.
 Grove cobbley sandy loam, 15 to 30 percent slopes
 Grove stony sandy loam, 0 to 5 percent slopes
 Harstine gravelly sandy loam, 5 to 15 percent slopes.
 Harstine gravelly sandy loam, 15 to 30 percent slopes.
 Hoodsport gravelly sandy loam, 0 to 5 percent slopes.
 Hoodsport gravelly sandy loam, 5 to 15 percent slopes
 Hoodsport gravelly sandy loam, 15 to 30 percent slopes
 Hoodsport stony sandy loam, 5 to 15 percent slopes.
 Hoodsport stony sandy loam, 15 to 30 percent slopes.
 Hoquiam gravelly silt loam, 5 to 15 percent slopes
 Hoquiam silt loam, 0 to 5 percent slopes.
 Hoquiam silt loam, 5 to 15 percent slopes.
 Hoquiam and Astoria silt loams, 5 to 15 percent slopes
 Indianola loamy sand, 0 to 5 percent slopes
 Indianola loamy sand, 5 to 15 percent slopes.

Indianola loamy sand, 15 to 30 percent slopes.
 Juno loamy sand, 0 to 3 percent slopes
 Lystair loamy sand, 0 to 5 percent slopes
 Lystair loamy sand, 5 to 15 percent slopes
 Lystair sandy loam, 15 to 30 percent slopes.
 Pilchuck loamy sand, 0 to 3 percent slopes
 Shelton gravelly sandy loam, 15 to 30 percent slopes
 Sinclair shotty loam, 15 to 30 percent slopes
 Sol Duc gravelly sandy loam, 0 to 5 percent slopes.

Subclass VIIe.—Coarse- and medium-textured, hilly and steep soils that are highly erodible if not protected. In this subclass are:

Alderwood gravelly sandy loam, 30 to 45 percent slopes
 Astoria silt loam, 5 to 15 percent slopes
 Astoria silt loam, 15 to 30 percent slopes
 Cloquallum silt loam, 15 to 30 percent slopes
 Delphi gravelly loam, 15 to 30 percent slopes.
 Grove gravelly sandy loam, 30 to 45 percent slopes.
 Hoodsport gravelly sandy loam, 30 to 45 percent slopes
 Hoquiam gravelly silt loam, 15 to 30 percent slopes.
 Hoquiam silt loam, 15 to 30 percent slopes.
 Hoquiam loam, 15 to 30 percent slopes
 Hoquiam and Astoria silt loams, 15 to 30 percent slopes.
 Kitsap silt loam, 15 to 30 percent slopes
 Shelton gravelly sandy loam, 30 to 45 percent slopes
 Shelton-Astoria complex, 15 to 30 percent slopes
 Tebo gravelly loam, 15 to 30 percent slopes
 Tebo gravelly loam, 30 to 45 percent slopes
 Tebo loam, 15 to 30 percent slopes
 Tebo-Astoria complex, 15 to 30 percent slopes.

Class VII.—Soils in class VII have very severe limitations that make them unsuited for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIIs.—Coarse-textured, droughty, alluvial soils subject to periodic flooding. The soils in this subclass are:

Pilchuck gravelly loamy sand, 0 to 3 percent slopes.
 Pilchuck sand, shallow, 0 to 3 percent slopes.

Subclass VIIe.—Steep miscellaneous land types. In this subclass is:

Rough broken land

Subclass complex—VIe and VIIe.—The soils in this subclass complex are:

Rough mountainous land, Hoodsport soil material.
 Rough mountainous land, Tebo soil material.
 Rough mountainous land, Tebo Shelton complex.

Class VIII.—Soils and land forms in class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or esthetic purposes. The soils in this class are:

Coastal beach, 0 to 2 percent slopes
 Orcas peat, 0 to 2 percent slopes
 Orcas peat, shallow over gravel, 0 to 2 percent slopes.
 Made land
 Riverwash, 0 to 3 percent slopes
 Tidal marsh, 0 to 2 percent slopes

Woodland Management ³

Soil productivity affects the growth of trees and their response to management. This quality is fairly easily recognized, and it can be measured.

³ By WILLIAM J. LLOYD, woodland conservationist, SCS.

Site Classes

Like other plants, trees grow more rapidly and produce more wood on some soils than on others. The capacity of soil to produce wood can be measured and described in units per acre, just as the productivity of wheatland can be described in bushels per acre. However, wood crops are measured in many different units, and it is, therefore, more convenient to use site classes as a relative measure of a soil's wood-producing ability. Under this system, the highest producing soil is designated as site class 1, and the lowest, as site class 5. Soils in classes 2, 3, and 4 have intermediate wood-producing capacity. The grouping of soils into site classes is based on the average total height of the dominant and codominant trees at the age of 100 years. These are the larger trees whose crowns form the general level of the forest canopy and occasionally extend above it.

Dominant and codominant trees, at an age of 100 years in well-stocked stands growing on site class 1 soils, will reach heights ranging from 190 to 210 feet; those on site class 2 soils, heights of 160 to 180 feet; on site class 3, heights of 130 and 150 feet; on site class 4, heights of

100 to 120 feet; and on site class 5, heights of 70 to 90 feet.

Table 7 shows site classes of the soil series in Mason County. The series are grouped according to their topographic position and parent material.

The site classes of soils refer to their productivity for Douglas-fir, and they were determined according to procedures described in USDA Technical Bulletin 201 (10) and in the work of other researchers on this subject.

Forest management is closely related to soil productivity. For example, if an owner has much soil not fully stocked with desirable trees, or if it is in need of planting, he should first plant seedlings on the soils of highest potential productivity and plant those of lower productivity last. Some owners are interested in pruning to improve the quality of trees for clear lumber or for veneer logs. Trees on the better soils should be pruned first because early financial gains from pruning depend upon rapid tree growth. It does not pay to prune trees on site class 5 soils; many owners consider pruning trees on site class 4 soils a debatable practice.

The growing of Douglas-fir for Christmas trees is an important enterprise in Mason County. Douglas-fir is

TABLE 7.—*Site classes of stated soil series according to topographic position*

Topographic position and parent material	Soil Series	Site class or relative rating ¹	Predominant forest trees
Soils on uplands developed from:			
Bedrock or glacial deposits	Astoria	1 and 2	Douglas-fir.
	Hoquiam	1 and 2	Douglas-fir.
	Tebo	1 and 2	Douglas-fir.
Glacial till; substrata cemented or compact	Alderwood	4 and 5	Douglas-fir.
	Delphi	3 and 4	Douglas-fir.
	Harstine	4 and 5	Douglas-fir.
	Hoodsport	4 and 5	Douglas-fir.
	Shelton	3 and 4	Douglas-fir.
	Sinclair	3 and 4	Douglas-fir.
Loose, gravelly glacial outwash or drift	Carstairs	3 and 4	Douglas-fir.
	Everett	4 and 5	Douglas-fir.
	Grove	3 and 4	Douglas-fir.
Loose, sandy glacial outwash or drift	Indianola	3 and 4	Douglas-fir.
	Lystair	3 and 4	Douglas-fir.
Glacial lake sediment; subsoil moderately fine textured	Cloquallum	2 and 3	Douglas-fir.
	Kitsap	3 and 4	Douglas-fir.
	Nordby	3 and 4	Douglas-fir.
	Saxon	3	Douglas-fir.
Soils on terraces and alluvial fans	Belle	Fair	Fir, cedar, hemlock, and deciduous trees.
	Le Bar	1 and 2	Douglas-fir.
	Nasel	4	Douglas-fir.
	Sol Duc	3 and 4	Douglas-fir.
	Wadell	3	Douglas-fir.
Soils on upland depressions	Bellingham	Fair	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	Deckerville	Fair	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	Edmonds	Good	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	Koch	Good	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	McKenna	Poor	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	Norma	Fair	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.
	Stimson	Fair	Red alder, Oregon-maple, willow, hemlock, spruce, and redcedar.

See footnotes at end of table.

TABLE 7.—*Site classes of stated soil series according to topographic position—Continued*

Topographic position and parent material	Soil Series	Site class or relative rating ¹	Predominant forest trees
Soils on alluvial bottom land, well drained to poorly drained.	Belfast	Fair	Fir, redcedar, hemlock, and deciduous trees.
	Dungeness	Good	Fir, redcedar, hemlock, and deciduous trees.
	Eld	Good	Fir, redcedar, hemlock, and deciduous trees.
	Juno	Fair	Fir, redcedar, hemlock, and deciduous trees.
	Maytown	Good	Fir, redcedar, hemlock, and deciduous trees.
	Pilchuck	Poor	Fir, redcedar, hemlock, and deciduous trees.
	Puget	Good	Redcedar, red alder, and Oregon-maple.
	Skokomish	Good	Fir, redcedar, hemlock, and deciduous trees.
	Nuby	Good	Redcedar, red alder, and Oregon-maple.
	Wapato	Good	Redcedar, red alder, and Oregon-maple.
Rough mountainous land	Tebo soil material.	2 and 4	Douglas-fir.
	Tebo-Shelton complex.	2 and 4	Douglas-fir.
	Hoodsport soil material.	4 and 5	Douglas-fir.

¹ Site classes or relative ratings apply to all mapping units in the series.

suitable for Christmas trees only when the distance between whorls of branches is relatively short, as they are on the poorer sites. If the distance between whorls is too long, the tree has too little foliage for a salable Christmas tree. For this reason, soils of site classes 4 and 5 are preferred for the production of Christmas trees.

Woodland Suitability Groups

In addition to productivity, the soil influences forest management in other ways. Forest management described by groups of related soils follows.

Woodland suitability group 1

Soils in this group belong to the Astoria, Hoquiam, Tebo, and Le Bar series. They are upland soils that have developed from bedrock or from glacial deposit. The Le Bar soils are terrace soils.

The soils are stable and do not present severe management problems, but they tend to be restocked by less desirable species after the harvest of Douglas-fir and hemlock. These soils are suitable for intensive management. Wood production declines if weed species claim the area. Mature stands of trees should be clear cut in blocks containing less than 40 acres, so as to provide a nearby seed source in uncut trees. Cutover areas should be replanted soon after logging if brush is likely to invade before the forest trees reseed. Spraying or slashing of overtopping brush and trees may be necessary during the first 5 to 10 years following restocking to release the Douglas-fir seedlings from competition.

Woodland suitability group 2

Soils in this group belong to the Alderwood, Delphi, Harstine, Hoodsport, Shelton, and Sinclair series. They are upland soils that have developed from glacial till and have compact or cemented substrata.

Trees grow slowly on these soils; consequently, they are used intensively for Christmas trees. The soils are fairly good for Douglas-fir, but hardwoods have estab-

lished themselves in many areas. Red alder usually occurs where surface drainage is slow.

The productivity of these soils varies according to texture. The gravelly and stony loamy sands are in site class 5, and the finer textured soils are in site class 4.

Where the underlying cemented or compact layer is at moderate depths, trees are more easily windthrown. When harvested, trees should be clear cut in blocks containing 2 acres or more. Seed trees should be left in groups of an acre or more to prevent windthrow.

The roots of trees are near the surface, and in some places they are exposed. Logging equipment damages the roots of trees left to grow and may cause entrance of rot-producing fungi. Permanent access roads as straight as possible should be built through forests on these soils to minimize damage. Very light equipment, or horses, should be used for yarding logs toward main trails and roads.

Woodland suitability group 3

Soils in this group belong to the Everett, Grove, Indianola, and Lystair series. They are upland soils that have developed from glacial outwash or drift and have friable substrata.

Forests on this group consist mainly of Douglas-fir and some lodgepole pine. In places, pure stands of lodgepole pine occur. The poor sites are ideally suited to the production of Christmas trees, because Douglas-fir readily restocks cutover areas and competing hardwoods are not a problem. Trees have deep, well-anchored root systems, so windthrow does not commonly occur. Heavy equipment does not damage tree roots; consequently, it can be used in these forests the year round.

Woodland suitability group 4

Soils in this group belong to the Cloquallum, Kitsap, Nordby, and Saxon series. They are upland soils that have developed from glacial lake sediment.

Forests on these soils are mixed—predominantly maple and alder, but also considerable Douglas-fir. Because of the presence of hardwoods and better growing conditions,

these soils are less commonly used for the production of Douglas-fir to be cut for Christmas trees. The root systems of trees are shallow, and windthrow is a hazard. This is particularly true when the soils are saturated or where trees are growing in places that are shallow to the underlying fine-textured subsoil.

Woodland suitability group 5

Soils in this group belong to the Bellingham, Decker-ville, Norma, Stimson, McKenna, Edmonds, and Koch series. They are poorly drained soils in upland depressions.

Forests on these soils consist mainly of hardwoods. The predominant species are red alder, Oregon-maple, willow, hemlock, spruce, and redcedar. Less common are Oregon-ash, aspen, and Douglas-fir. Willow and aspen are the main species on fine-textured soils having restricted drainage. Alder and maple predominate on the soils of coarser texture that have less standing water. Drainage is the main problem in management. The removal of standing water greatly increases the growth of trees.

Any kind of partial cutting is difficult on these soils because root systems are shallow. Trees often grow on top of old stumps, hummocks, and mounds.

Ground vegetation under the hardwood trees consists of dense elderberry, spirea, swordfern, salmonberry, vine maple, and trailing blackberry. These species completely occupy the soil when the overhead canopy is cut, and they effectively prevent the restocking of desirable trees. Logging in these areas should be followed by removal of competing vegetation and by the stirring of soil to assure reseeding of desirable forest trees.

Woodland suitability group 6

Soils in this group belong to the Belfast, Maytown, Skokomish, Nuby, Puget, and Wapato series. They are imperfectly drained to poorly drained alluvial soils.

Forests on the Nuby and Wapato soils consist mainly of redcedar, red alder, and Oregon-maple; those on the other soils are fir, cedar, hemlock, and deciduous trees.

Productivity for trees depends on drainage. If drainage is poor, management is similar to that described for woodland suitability group 5, and, if drainage is good, productivity improves and may be very good.

Woodland suitability group 7

Soils in this group belong to the Dungeness, Eld, Juno, and Pilchuck series. They are well-drained alluvial soils.

Forests consist of fir, hemlock, cedar, alder, Oregon-maple, and cottonwood. Productivity is high on soils dominated by cottonwood, and it is the species preferred for this group of soils. Douglas-fir is the preferred evergreen tree, but hemlock and cedar are also suitable.

Harvesting should be by the clear-cutting method and followed by planting of the logged area with desirable trees. Brush invades logged areas, and it must be controlled by cutting or chemical spraying.

Yield and Stand Data

The average yields per acre that can be expected from well-stocked stands of Douglas-fir, when growing on stated sites, are shown in table 8.

TABLE 8.—*Yield and stand data, per acre, for well-stocked natural stands of Douglas-fir when growing on stated site classes¹*

SITE CLASS 1 (Site Index)

Age of stand	Stand volume		Periodic annual growth ²	Average diameter of trees	Number of trees
	Trees 7 to 12 inches diameter	Trees 12 inches and larger			
Years	Cords	Board-feet ³	Board-feet ³	Inches	
20	11.4	8,000	1,640	5.7	571
30	29.0	21,400	1,970	9.0	350
40	19.3	44,100	1,790	12.2	240
50	9.5	62,000	1,620	15.3	176
60	5.0	78,200	1,430	18.2	138
70	1.9	92,500	1,230	20.9	113
80	1.3	104,800	—	23.3	97
90	3	—	—	25.6	84

SITE CLASS 2 (Site Index)

20	—	—	260	4.5	880
30	28.2	2,600	930	7.0	555
40	35.1	11,900	1,540	9.4	385
50	26.9	27,400	1,550	11.8	290
60	16.0	42,800	1,440	14.0	228
70	9.3	57,200	1,280	16.0	186
80	5.5	70,000	1,105	17.9	159
90	3.4	81,000	—	19.6	138

SITE CLASS 3 (Site Index)

20	1.7	—	30	3.4	1,460
30	20.6	300	420	5.5	865
40	35.2	4,500	790	7.4	585
50	38.3	12,400	1,140	9.3	430
60	31.7	23,800	1,140	11.1	337
70	22.7	35,200	1,050	12.8	274
80	15.6	45,700	930	14.3	232
90	10.7	55,000	—	15.6	205

SITE CLASS 4 (Site Index)

20	—	—	—	2.2	3,069
30	7.0	200	310	3.9	1,472
40	22.1	—	—	5.5	927
50	32.5	3,300	480	7.0	659
60	36.3	8,100	590	8.5	500
70	34.3	14,000	610	9.8	405
80	29.8	20,100	590	10.9	345
90	24.4	26,000	—	11.9	304

SITE CLASS 5 (Site Index)

20	—	—	—	1.3	6,920
30	—	—	—	2.6	2,700
40	4.2	—	—	3.8	1,530
50	14.0	30	107	4.9	1,050
60	22.5	1,110	130	6.0	780
70	27.9	2,400	200	7.0	625
80	30.3	4,400	250	7.9	525
90	30.0	6,900	—	8.7	451

¹ According to USDA Tech. Bul. 201 (10).

² Average growth each year in the decade, beginning at age shown opposite in column on left.

³ According to Scribner rule.

Statistics

The ownership of commercial forest land in Mason County is shown in table 9, and the extent of the major forest types is shown in table 10.

TABLE 9.—*Commercial forest area by ownership and stand-size class, 1951, in Mason County, Wash. (11)*

Ownership class	Total	Saw-timber stands	Pole-timber stands	Seedling and sapling stands	Non-stocked areas
Private	348,020	68,340	180,430	96,680	2,570
State	59,530	4,840	22,590	30,760	1,340
Municipal	4,560	740	2,370	1,250	200
National forest	102,950	88,520	5,820	8,330	280
Public domain	350	100	240	10	—
Indian	4,600	1,600	2,330	670	—
Total	520,010	164,140	213,780	137,700	4,390

TABLE 10.—*Commercial forest area by major forest types and stand-size class, 1951, Mason County, Wash. (11)*

Forest type	Total	Saw-timber stands		Pole-timber stands	Seedling and sapling stands	Nonstocked areas
		Old growth	Young growth			
Douglas-fir	432,270	29,830	86,600	187,750	128,090	—
Western hemlock	32,980	29,570	1,110	1,780	520	—
Sitka spruce	300	160	—	140	—	—
Western redcedar	1,680	680	330	570	100	—
White pine	570	—	120	160	290	—
Ponderosa pine ¹	200	—	—	—	200	—
Lodgepole pine	9,750	—	—	1,930	7,820	—
True fir and mountain hemlock	7,040	7,040	—	—	—	—
Hardwoods	30,830	—	8,700	21,450	680	—
Nonstocked	4,390	—	—	—	—	4,390
Total	520,010	67,280	96,860	213,780	137,700	4,390

¹ Ponderosa pine is not native to this county, the area shown is a plantation.

Genesis, Morphology, and Classification of Soils

The purpose of this section is to present the outstanding morphologic characteristics of the soils of Mason County and to relate them to the factors of soil formation.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated through geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the relief or lay-of-the-land, (4) the plant and animal life in and on the

soil, and (5) the length of time the forces of soil development have acted on the soil material.

A wide range of environment and of parent materials has created a large number of soil series in Mason County. This range in conditions is caused by the complex origin and composition of the glacial deposits, the diversity of the country rock, the uneven relief, and the variations in drainage, climate, and vegetative cover. The differences in soils were caused largely by differences in parent materials, relief, and age of the soils.

Climate

The climate of Mason County is influenced by the Olympic Mountains. More rain falls near the bases of the mountains than farther east on the glacial plain. The rainfall increases from an average low of 51 inches along the eastern border of the county to about 100 inches near the Olympic Mountains. Precipitation falls as

gentle rains. During the winter many of the days are overcast or foggy. Snowfall is intermittent during winter and soon melts. In the higher mountains the snowfall is heavy and stays on the ground until late in spring. The higher peaks have snow patches or glaciers throughout the summer. Temperature and precipitation data are given in table 1.

Vegetation

Nearly all the surveyed area was covered originally by a dense coniferous forest and dense understory of shrubs, bushes, ferns, and mosses. Cutover or burned areas reseed quickly and naturally to their original species. Deciduous and water-tolerant trees grow in the bogs and swamps, on seepage slopes, and on wet lowlands. The few open prairies are under a cover of grasses and herbs.

Parent material and relief

Perhaps the most important environmental factor in determining the different soils has been the parent material. The main geologic features are the Olympic Mountains, the Black Hills, and the deposits of glacial drift on the lower lying areas. The Olympic Peninsula, during the Tertiary period, was a large peneplain. Near the end of the Pliocene era, it was uplifted and the Olympic Mountains were formed. These mountains consist almost entirely of quartzites and slates, with some basic eruptive rocks along the northern, eastern, and southern borders. Granites have not been found in place, and volcanic cones do not occur as in the Cascades (1). The peaks are residual monadnocks consisting mainly of metamorphic rocks (9).

The lower lying Black Hills of Thurston County are on the southern border of Mason County. They consist of Tertiary shale, sandstone, and basalt and were uplifted at the end of the Pliocene era. The Black Hills are part of the general uplift area that extends across the lower Puget Sound Basin from the base of the Cascades, near Morton, to the lower end of the Olympic Mountains. The Blue Hills are outside the county, but are near the northeastern corner. They also consist of uplifted Tertiary beds of basalt, sandstone, and shale. The Black Hills and Blue Hills are more rounded, are less precipitous, and have lower elevations than the Olympic Mountains.

Glaciation dominates the geological history of most of the county. Nearly all the land below an elevation of 600 feet, and in some instances below 1,000 feet or more, was covered by glacial deposits laid down during the Pleistocene era. There were three Pleistocene epochs: The Admiralty glacial, the Puyallup interglacial, and the Vashon glacial. Most of the major terrain features, other than the mountains, were set during the Puyallup interglacial epoch. The Vashon glacier advanced farther than the Admiralty, and it covered all previous glacial material.

The Vashon and Admiralty glaciers originated in the Cordilleran glacier of British Columbia. The Vashon glacier covered the whole area with a thin layer of glacial till and outwash material. The glacier melted fairly rapidly, and land forms that had developed during the Puyallup interglacial period were little modified. The area covered by outwash was great. It is a nearly

level, gravelly plain extending from north of Shelton to the Skokomish River and west to and beyond Matlock. Outwash waters followed two main courses; one was west of the Black Hills through Mason County, and the other was east of the Black Hills through Thurston County. At the height of the glacier, two smaller outwash outlets were formed in Mason County. They were through the Simpson col and Lost Prairie. However, as the glacier receded, the outwash began to flow eastward into Lake Russell. With the clearing of Hammersley Inlet, Lake Russell backed up into Shelton Valley and Oakland Bay. The highest level of the water was about 160 feet above present sea level.

At one time outwash waters from Hood Canal flowed into Lake Russell and formed a large delta escarpment on the north side of Shelton. Later, glacial Lake Skokomish was formed when the glacier receded northward. This lake filled the area that extended from east of Belfair and up the Skokomish River to an elevation of about 350 feet above sea level. Unlike the others, this lake was short lived, and the lacustrine sediments were not thick. Remnants of these glacial lake deposits can be seen on the soil map from the delineation of the Kitsap, Cloquallum, and Saxon soils.

The glacial deposits are largely granitic. The Vashon till is a grayish, arenaceous, compact or cemented material containing scattered, rounded granitic gravel. Large stones are essentially absent, but they are scattered over the surface. The Admiralty till is similar to the Vashon till but is darker and contains more boulders (1). In the western part of the county, many fragments of angular basaltic or basic igneous rock, alien to the continental glacial tills, are mixed in the solum and scattered over the surface. This basic material probably was acquired as the glacier covered the lower limits of the Olympic Mountains, the Blue Hills, and the Black Hills. These fragments of basic rock may have been carried by glaciers from higher elevations in the Olympic Mountains. The Vashon glacier covered the large plateau that extends from west of the Hood Canal to Lake Cushman, and it even pushed up into the Skokomish River Canyon (1). However, the Olympic glaciers were formed prior to the far advance of the continental glacier that subsequently overrode the local glaciers and incorporated their material with it. A dark-colored till overlying the Admiralty drift (1) is on the east side of the Hood Canal midway between the mouths of the Hamma and Lilliwaup Rivers. This drift is composed of subangular pebbles of basalt and metamorphosed sedimentaries. This fact indicates that a piedmont condition accompanied the Olympic glaciers. If this is correct, much mountain glacial material was in a position to modify and become incorporated with the Vashon till in a large part of the county. These conditions helped form the till that was the parent material for the Shelton, Hood sport, and other reddish-colored glacial soils.

Time

Except for Alluvial soils, the soils of Mason County have been developing since the retreat of the last glacier—the Vashon glacier—that covered the Puget Sound area. The glacial materials from which the soils have formed were deposited near the close of the Pleistocene epoch.

Characteristics of the Soils

In some instances, certain factors of soil genesis have been dominant over others in the formation of the soils. In many of the series, the nature and composition of the glacial deposits have controlled the formation of soils; in others, drainage; in others, climate and vegetation; and for some soils, the length of time the forces have operated has determined their major characteristics.

The dominant characteristics of normally developed, well-drained soils are (1) a thin organic mat, (2) a very thin A_1 layer, (3) the lack of an A_2 layer in most cases, and (4) a rather abrupt change to a B_{2r} , or a weak podzol B horizon. The solum is quite uniform in texture throughout; contains many shotlike pellets, or concretions; but lacks strongly developed structural features. It is difficult to separate the solum into A and B horizons other than by differences in color. The solum rests fairly abruptly on a glacial drift, of which only the upper part has been modified by weathering. This indicates that the parent material has not weathered long enough, or that the forces of weathering have not been strong enough, to greatly modify the parent material.

Along a narrow strip in the eastern part of the county bordering Puget Sound, where winter temperatures are milder and rainfall is the lowest, the Sinclair and Harstine soils have a grayish color. In the central part of the county, midway toward the Olympic mountains, the Alderwood and Everett soils have a brown B_{2r} horizon and a pale-brown B_3 horizon. In the western part of the county where the rainfall is higher and winter temperatures only slightly lower, the Shelton and Grove soils have a brown to reddish-brown B_{2r} horizon that is underlain by a reddish-yellow or light-brown B_3 horizon. The Shelton and Grove soils have developed from parent materials that are higher in basic rock, which is the main source of their reddish color. Soils of the Tebo series have developed from residual basalt, and they are reddish brown. The adjacent soils belonging to the Astoria series have developed from weathered Tertiary sandstone and shale and have a dark-brown or dark reddish-brown A_1 horizon and a brown and yellowish B horizon.

Soils that have developed under an acid organic mat are medium acid. The organic mat is from 1 to 2 inches thick but is much thinner than expected, considering the climate and denseness of vegetative cover. There is no gray, leached A_2 layer or accumulation of colloids. However, there is a very weak accumulation of sesquioxides. The combination of wet winters and dry summers evidently does not allow the normal development of podzolic soils; "shot" forms instead of ortstein. The shot, or concretions, were once believed to indicate the accumulation of sesquioxide, but the evidence in some soils reveals them to be weathered fragments of the parent rock. Shot, or concretions, are pieces of porous, weathered rock having a brownish outer shell; they consist of iron oxides diffused outwardly from the inside of the concretion.

Wheating (20) attributes the formation of shot to the dry summers, during which time, chemical and biological activities are at their maximum and the supply of moisture is at a minimum. In many instances there is not enough percolating water to leach the soil and carry

the dissolved sesquioxides downward. Instead, the soil moisture is found in minute areas of damp soil that are surrounded by large areas of dry soil. On further drying, the iron and aluminum in solution are deposited around grains of sand, small pebbles, or other nuclei. Subsequent wetting and drying builds up these nuclei until shot pellets high in iron and aluminum are formed. The sesquioxides are not clearly precipitated, but they lodge on particles of soil and cement them together around the original nuclei. The shot range in size from that of medium sand to pellets as large as hazelnuts. Under this type of weathering, the solum can be considered an A_2 horizon that contains a dispersed B_2 horizon.

Soils with capacities to hold greater quantities of moisture, as the Kitsap and Sinclair soils, form the greatest number of shot. Although the somewhat excessively drained Everett soils form shot, the formation of it cannot be attributed to restricted drainage. Poorly drained soils and the prairie soils never contain shot. In cooler climates and at higher elevations, the prevalence of shot decreases and the shot gradually disappear. The Hoodsport soils on a high plateau adjacent to the Olympic Mountains have formed under higher rainfall and cooler temperature, and they contain much less shot than the Alderwood soils.

Classification of Soils by Higher Categories

Soils are classified into categories that are progressively more inclusive. The lowest categories commonly used in the field are discussed in the section Soil Survey Methods and Definitions. The higher categories of classification, called great soil groups and orders, are discussed in this section. The great soil groups consist of soil series that show the same general sort of profile but differ greatly in kinds of parent material, relief, and degree of development. Soils are classified into three orders—zonal, intrazonal, and azonal.

Zonal soils have well-defined characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms. The zonal soils that have developed on the forested uplands are mainly brown, moderately coarse textured, and permeable. They are acid in reaction.

Intrazonal soils have characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation. In Mason County the intrazonal soils have been affected by poor and very poor drainage. The soils have developed in low-lying depressed areas under forest or swamp vegetation.

Azonal soils lack distinct, genetically related horizons because of their youth, resistant parent material, or steep topography.

The soils in Mason County, like those of the rest of western Washington, do not fit well into the great soil groups defined in Soils and Men (18) and modified by Thorp and Smith (17). The discrepancies are probably largely due to the climate of the region, which differs from that of the rest of the United States. In this region of wet winters and dry summers, the processes of soil development normal to other regions are modified.

During summers, when the temperature is optimum for chemical and biological activity, the moisture supply necessary for that activity is lacking. During winter, when moisture supply is more than adequate, cool temperatures hold the chemical and biological activity to a minimum.

Even though they do not conform entirely to the characteristics of the great soil groups as defined, many of the soils lean heavily toward one group or another. The limited amount of study and analytical data, however, makes it difficult to place the soils satisfactorily in specific

groups. Some soils are transitional between two of the great soil groups; others have the aspects of one group but, in addition, conform with many of the characteristics of another group.

Table 11 classifies the soil series of Mason County according to great soil groups and soil orders. Following the table, the great soil groups, and the soil series in each group, are discussed, and some relationships of the series are mentioned. As pointed out, the placement of the series in great soil groups is tentative and may be revised as more knowledge is gained.

TABLE 11. *Soil series classified by order and great soil groups, and some factors that have contributed to their morphology*

ZONAL SOILS

Great soil group and series	Relief	Natural drainage	Parent material
Brown Podzolic:			
Alderwood	Rolling to steep	Good	Gravelly glacial till.
Everett	Gently undulating to hilly	Somewhat excessive	Gravelly glacial drift.
Grove	Gently undulating to hilly	Somewhat excessive	Gravelly glacial drift.
Harstine	Rolling to steep	Good	Sandy glacial till.
Hood sport	Undulating to steep	Good	Gravelly glacial till.
Indianola	Undulating to hilly	Somewhat excessive	Sandy glacial drift.
Lystair	Undulating to hilly	Somewhat excessive	Sandy glacial drift.
Shelton	Rolling to steep	Good	Gravelly glacial till.
Sinclair	Undulating to hilly	Moderately good	Gravelly glacial till
Sol Duc	Gently sloping	Somewhat excessive	Mixed glacial gravel.
Brown Podzolic intergrading to Gray-Brown Podzolic:			
Clouallum	Undulating to rolling	Moderately good	Glacial lake sediment
Kitsap	Undulating to rolling	Moderately good	Glacial lake sediment.
Nordby	Undulating to rolling	Good	Glacial lake sediment.
Saxon	Rolling	Good	Glacial lake sediment.
Yellowish-Brown Lateritic:			
Astoria	Rolling to hilly	Good	Shale and sandstone.
Belle	Gently sloping	Good	Mixed sedimentary material.
Delphi	Rolling to hilly	Good	Glacial till over basalt.
Hoquiam	Rolling to hilly	Good	Mixed old terrace
Le Bar	Gently sloping	Good	Compact mixed terrace material.
Tebo	Rolling to steep	Good	Basic igneous rock and mixed glacial material.

INTRAZONAL SOILS

Humic Gley:			
Bellingham	Nearly level	Poor	Glacial lake sediment.
Deckerville	Nearly level	Poor	Gravelly drift
McKenna	Nearly level	Poor	Gravelly drift.
Norma	Nearly level	Poor	Sandy drift
Low-Humic Gley:			
Edmonds	Nearly level	Poor	Sandy glacial drift
Koch	Nearly level	Imperfect to poor	Gravelly drift.
Stimson	Nearly level	Poor	Mixed old terrace.
Bog:			
Mc Murray peat	Nearly level	Very poor	Woody peat accumulations.
Mukilteo peat	Nearly level	Very poor	Sedge accumulations
Orcas peat	Nearly level	Very poor	Moss accumulations
Semiahmoo muck	Nearly level	Very poor	Sedge accumulations.
Tacoma peat	Nearly level	Very poor	Sedge accumulations and marine sediment.
Tanwax peat	Nearly level	Very poor	Sedimentary organic accumulations.

TABLE 11.—*Soil series classified by order and great soil groups, and some factors that have contributed to their morphology—Continued*

AZONAL SOILS

Great soil group and series	Rehof	Natural drainage	Parent material
Alluvial:			
Belfast	Gently undulating	Moderately good	Glacial alluvium.
Dungeness	Gently undulating	Moderately good	Glacial alluvium mainly from quartz and slate
Eld	Gently undulating	Moderately good	Basaltic and sedimentary alluvium
Juno	Gently undulating	Somewhat excessive	Glacial alluvium
Maytown	Gently undulating	Moderately good	Basaltic and sedimentary alluvium.
Nuby	Gently undulating	Poor to somewhat poor	Glacial alluvium
Pilchuck	Gently undulating	Somewhat excessive	Glacial alluvium mainly from quartz and slate.
Puget ¹	Gently undulating	Poor	Glacial alluvium mainly from quartz and slate
Skokomish ¹	Gently undulating	Imperfect	Glacial alluvium mainly from quartz and slate
Wadell ²	Gently sloping	Good	Basaltic alluvium.
Wapato ¹	Gently undulating	Poor	Basaltic and sedimentary alluvium.
Ando:			
Carstairs	Nearly level	Somewhat excessive	Gravelly glacial drift
Nasel	Gently sloping	Good	Compact gravelly drift

¹ Has some of the characteristics of Low-Humic Gley soils.² Has some of the characteristics of Reddish-Brown Lateritic soils.**Zonal soils**

The zonal soils in Mason County are members of the Brown Podzolic, Brown Podzolic intergrading to Gray-Brown Podzolic, and Yellowish-Brown Lateritic great soil groups.

BROWN PODZOLIC SOILS

The Brown Podzolic soils of northeastern United States are described (18) as imperfectly developed podzols having an organic mat on the surface and a very thin, gray, leached horizon just below. The B horizon is usually yellowish brown and has only the beginnings of a dark-brown orterde just below the gray A horizon. The total depth of the solum is usually less than 30 inches.

The Brown Podzolic soils in Mason County are members of the Alderwood, Everett, Grove, Harstine, Hoodsport, Indianola, Lystair, Shelton, Sinclair, and Sol Duc series. All of these show the characteristics of weakly developed Brown Podzolic soils.

In many respects, the Alderwood, Everett, and Indianola soils conform to the foregoing description. They differ from eastern Brown Podzolic soils in containing shot, or coated fragments of weathered rock; in the absence of a leached layer below the A₀ horizon; and in the lack of a strongly developed orterde in the upper part of the solum. An exhaustive search sometimes reveals traces of an ashy gray layer in the soils of sandier texture. Logging has destroyed the A₂ horizon. Podzolization is much more prevalent in the rarely occurring areas of virgin forest.

Alderwood series

The following profile of Alderwood gravelly sandy loam is typical of the Brown Podzolic soils in Mason County. The vegetation consists largely of young Douglas-fir and hemlock trees and a dense undergrowth of vine maple, alder, vines, shrubs, ferns, Oregon-grape, and salal.

A ₀₀ and A ₀	2 to 0 inches, very dark grayish-brown (10YR 3/2) partly decomposed, loose litter of fir needles, leaves, twigs, fern fronds, moss, and roots; pH 5.2 to 5.6; lower part more highly decomposed and darker colored than upper part, and it contains some mineral matter; lower boundary abrupt
B _{21,ir}	0 to 13 inches, dark-brown (7.5YR 3/2, moist) to brown or yellowish-brown (10YR 5/3 5, dry) gravelly sandy loam; weak, fine, granular structure; soft, friable, nonsticky, and nonplastic; many, small, rounded, extremely hard pellets locally known as shot, which are cemented by impure iron oxides; numerous roots; pH 5.7; gravel and pebbles partly coated by fine, dark reddish-brown material.
B _{22,ir}	13 to 23 inches, dark yellowish-brown (10YR 4/4, moist) to pale-brown or light yellowish-brown (10YR 6/3 5, dry) gravelly sandy loam; weak, fine, granular structure to single grained; very friable, loose, nonsticky, nonplastic; less shot than in the horizon above, pH 5.7; roots numerous; more gravelly than horizon above; gravel partly and thinly coated by fine reddish-brown material; lower boundary clear, wavy.
B ₃	23 to 28 inches, yellowish-brown (10YR 5/4, moist) to very pale brown (10YR 7/3, dry) gravelly sandy loam; horizontal streaks and localized mottles of reddish brown, brown, and yellow; massive to single grained; slightly hard, firm, nonsticky, nonplastic, mat of roots rests on impervious material below; pH 5.4, lower boundary abrupt, wavy.
C ₁₁	28 to 38 inches, dark-gray (10YR 4/1, moist) to light-gray, (10YR 7/2, dry), compact, gravelly sandy loam glacial till; strongly cemented or indurated by siliceous material; prominently mottled with yellow and reddish brown; upper few inches contain successive, thin, wavy, fragmental plates; pH 5.8; lower boundary gradual, wavy.
C ₁₂	38 inches+, similar to C ₁₁ layer but not mottled or platy; usually more strongly cemented; pH 5.8; many feet thick.

TABLE 12.—*Chemical and particle-size*

Soil	Laboratory sample number	Horizon	Depth	Exchangeable cations					
				Calcium	Magnesium	Potassium	Sodium	Hydrogen	Sum of cations
Alderwood gravelly loam, profile No. 11 ²	49752	A ₀	2 to 0	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm.	meq /100 gm
	49753	A ₂	0 to $\frac{1}{2}$	4.0	1.0	0.3	0.2	27.6	33.1
	49754	B ₂₁	$\frac{1}{2}$ to 7	.8	.4	.1	.2	16.2	17.7
	49755	B ₂₂	7 to 22	.9	.4	.1	.2	13.3	14.9
	49756	B ₃₁	22 to 30	.7	.5	.1	.2	7.3	8.8
	49757	B ₃₂	30 to 33	.4	.3	.1	.2	5.5	6.5
	49758	C	33 to 40	.3	.2	.1	.3	3.5	4.4

¹ Data from USDA, Soil Survey Laboratory Memorandum No. 1, Beltsville, Md., 1952.² Location: King County, Wash.,

Table 12 shows the chemical and particle-size analyses of Alderwood gravelly loam in nearby King County, Wash. That soil is similar to Alderwood gravelly loam mapped in Mason County.

Everett and Indianola series

The Everett and Indianola soils have developed from loose, permeable drift. They are morphologically similar; they differ mainly in texture of the parent material and somewhat in topographic position and relief. The

Everett soils have developed from loose, usually stratified, gravelly drift; the Indianola soils, in contrast, are free of gravel and have developed from loose, sandy, unassorted drift. The Everett and Indianola soils contain fewer shot pellets and in color resemble the Alderwood soils. They are Brown Podzolic soils, but not so well developed as the Alderwood soils.

Harstine and Sinclair series

The Harstine and Sinclair soils are included in the Brown Podzolic group, although they are not typical of

TABLE 13.—*Chemical and particle-*

Soil	Laboratory sample number	Horizon	Depth	Exchangeable cations					
				Calcium	Magnesium	Potassium	Sodium	Hydrogen	Sum of cations
Sinclair shotty loam, profile No. 55 ²	501150	A ₀	$\frac{1}{4}$ to 0	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm
	501151	A _{1en}	0 to $\frac{1}{2}$	21.3	0.7	0.6	0.4	19.0	42.0
	501152	A _{3en}	$\frac{1}{2}$ to 5	6.7	.9	.5	.2	21.3	29.6
	501153	B _{2en}	5 to 10	1.3	.5	.4	.1	21.3	23.6
	501154	B _{22en}	10 to 17	1.5	.7	.4	.1	17.6	20.3
	501155	B ₃	17 to 22	2.2	2.1	.4	.2	13.2	18.1
	501156	M	22 to 22 $\frac{1}{4}$	2.2	2.0	.2	.1	7.8	12.3
	501157	MC	22 $\frac{1}{4}$ to 24	2.2	2.0	.3	.1	6.8	11.4
	501158	C	24 to 40	2.6	1.6	.2	.2	4.5	9.1
Sinclair shotty loam profile No. 56 ³	501159	A ₀	1 to 0	8.4	1.0	.6	.1	16.8	26.9
	501160	A _{1en}	0 to 3	2.9	.7	.5	.1	14.2	18.4
	501161	B _{1en}	3 to 10	1.0	.5	.4	.1	12.2	14.2
	501162	B _{2en}	10 to 17	1.1	.5	.3	.1	12.2	14.2
	501163	B _{22en}	17 to 25	1.8	.9	.2	.2	9.8	12.9
	501164	B ₃₁	25 to 33	3.0	1.6	.2	.2	9.0	14.0
	501165	B ₃₂	33 to 43	2.4	1.3	.1	.4	7.6	11.8
	501166	M	43 to 45	4.4	2.4	.1	.5	9.0	16.4
	501167	C	45 to 60						

¹ Data from USDA, Soil Survey Laboratory Memorandum No. 1, Beltsville, Md., 1952.² Location: Mason County, Wash., NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec 24, T. 21 N., R. 2 W. (approximately 13 miles northeast of Shelton) Sample collected under a Douglas-fir and a cedar tree.

analyses of Alderwood gravelly loam¹

Base saturation	pH	Organic carbon	Size classes								
			Clay less than (0.002 mm.)	International silt (0.02 to 0.002 mm.)	USDA silt (0.05 to 0.002 mm.)	Very fine sand (0.1 to 0.05 mm.)	Fine sand (0.25 to 0.1 mm.)	Medium sand (0.5 to 0.25 mm.)	Coarse sand (1 to 0.5 mm.)	Very coarse sand (2 to 1 mm.)	
Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
17	4.6	6.5	5.8	16.8	33.2	15.1	19.5	8.8	10.4	7.2	
8	5.3	1.81	4.9	16.8	32.5	16.1	19.4	8.3	10.6	8.2	
11	5.6	1.41	3.2	15.5	31.5	16.2	20.7	9.4	11.9	7.1	
17	5.6	.59	2.0	10.9	26.3	18.1	21.4	10.3	11.0	7.9	
15	5.8	.35	.5	9.1	25.1	17.8	26.3	11.2	11.6	7.5	
20	5.8	.21	.3	8.7	24.2	19.3	27.1	11.0	10.5	7.6	

SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T. 26 N., R. 6 E. approximately 3½ miles west of Duval. Sample collected on north side of road cut 30 feet high.

this group in some respects. These soils have developed from compact glacial till similar to the parent material of the Alderwood soils. The Harstine soils are most nearly similar to the Alderwood soils but differ in having a more pronounced A₂ horizon immediately below the organic litter and a duller, or grayer, B_{tr} horizon which appears to be intermingled with the A₂ and B_{2tr} horizons. The underlying till is not so strongly cemented and is less gravelly than that of the Alderwood soil.

The Sinclair soils have the most pronounced development of shot and grayish-brown color in the B_{tr} horizon. There is usually a thin, dark-colored A₁ horizon containing numerous shot immediately below the organic litter. The B_{tr} horizon also appears to be a combination of A₂ and B_{1tr} horizons. The underlying compact till is strongly cemented or indurated.

Table 13 shows the chemical and particle-size analyses of a Sinclair soil.

size analyses of Sinclair shotty loam¹

Base saturation	pH	Organic carbon	Free Fe ₂ O ₃	Size classes							
				Clay (less than 0.002 mm.)	International silt (0.02 to 0.002 mm.)	USDA silt (0.05 to 0.002 mm.)	Very fine sand (0.1 to 0.05 mm.)	Fine sand (0.25 to 0.1 mm.)	Medium sand (0.5 to 0.25 mm.)	Coarse sand (1 to 0.5 mm.)	Very coarse sand (2 to 1 mm.)
Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
55	6.0	4.94	1.52	16.8	27.2	39.5	11.0	14.4	7.4	6.8	4.1
28	5.5	2.92	1.84	17.4	27.8	40.2	9.7	12.5	6.5	7.2	6.5
10	5.0	1.30	1.88	17.2	25.9	37.3	9.4	12.4	6.7	8.6	8.4
13	5.2	1.10	1.68	17.0	25.6	37.4	9.9	13.4	7.1	8.6	6.6
27	5.0	.74	1.40	14.2	21.7	33.2	11.9	17.2	8.7	9.0	5.8
36	5.2	.23	1.60	10.2	17.8	35.0	9.4	21.7	9.4	8.7	5.6
40	5.2	.13	-----	8.1	15.8	27.9	13.5	18.6	9.0	12.1	10.8
50	5.2	.09	-----	7.7	15.5	28.5	14.4	21.6	10.0	10.6	7.2
	5.2	2.86	-----	12.1	18.6	29.8	10.0	19.7	11.0	10.2	7.2
38	5.5	1.49	-----	15.7	18.1	29.2	9.6	19.4	10.8	9.6	5.7
23	5.2	82	-----	14.5	18.7	30.3	9.8	19.4	10.7	9.4	5.9
14	5.3	71	-----	14.0	18.6	29.6	9.9	19.8	11.0	9.3	6.4
24	5.2	.51	-----	13.5	19.3	31.1	11.1	19.6	10.1	9.0	5.6
36	5.2	.38	-----	12.6	22.7	37.6	12.5	17.9	9.2	7.4	2.8
36	4.9	.12	-----	9.2	18.9	34.0	13.1	16.8	9.2	11.2	6.5
45	4.9	.12	-----	12.9	21.2	39.5	13.8	16.5	7.3	6.7	3.3

¹ Location: Mason County, Wash., SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T. 22 N., R. 1 W. (½ mile west of Allyn). Sample collected under a Douglas-fir tree.

Grove, Lystair, and Sol Duc series

Soils of the Grove, Lystair, and Sol Duc series have developed in an area that has from 60 to 90 inches of rain per year. The Grove soils have developed from loose, gravelly, glacial outwash material. The surface material is reddish brown and is underlain by a light-brown, very friable material. Grove soils are the most similar to the Everett soils, but the latter differ in having a pale-brown surface layer over light yellowish-brown material.

The Lystair soils differ from the Grove soils in having developed from loose, sandy glacial drift that is free

of gravel. In addition, they have a brown surface layer underlain by reddish-yellow material. The Indianola soils differ from the Lystair mainly in having a brown, instead of a reddish-brown, surface layer, which is underlain by a pale-brown, rather than light-brown, material.

The Sol Duc soils occur on terraces; they have developed from loose, mixed glacial materials derived predominantly from the Olympic Mountains. They differ from the Grove soils mainly in that the solum has a medium texture rather than moderately coarse and coarse texture. The Sol Duc soils are also not so red; they have a thin, brown to grayish-brown A₁ horizon underlain by a light yellowish-brown B horizon.

TABLE 14.—*Chemical and particle-size*

Soil	Labora-	Horizon	Depth	Exchangeable cations					
				Calcium	Magne-	Potas-	Sodium	Hydrogen	Sum of
	sample			meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm	meq /100 gm
Shelton gravelly sandy loam, profile No. 57 ²	501168	A ₀	Inches 1 to 0	8.3	1.0	0.6	0.2	22.5	32.6
	501169	A ₁	0 to 3	2.4	.9	.3	.1	17.3	21.0
	501170	A ₃	3 to 9	1.1	.9	.2	.1	14.6	16.9
	501171	B ₂	9 to 18	2.4	1.0	.2	.2	13.5	17.3
	501172	B ₃	18 to 27	2.6	.8	.1	.2	12.3	16.0
	501173	C _{m1}	27 to 36	4.4	2.1	.1	.3	11.6	18.5
	501174	C _{m2}	36 to 40 ³	4.9	1.6	.1	.3	7.9	14.8
Shelton gravelly sandy loam, profile No. 58 ⁴	501176	A ₀	1 to 0	9.2	1.5	.8	.3	37.5	49.3
	501177	A ₁	0 to 2	3.4	.6	.4	.2	27.4	32.0
	501178	A ₃	2 to 9	.6	.3	.2	.2	16.9	18.2
	501179	B ₂	9 to 17	.5	.2	.1	.1	13.4	14.3
	501180	B ₃	17 to 30	.3	.2	.1	.1	12.0	12.7
	501181	MC	30 to 32	.1	.1	.1	.1	8.5	8.8
	501182	C	32 to 42						

¹ Data from USDA, Soil Survey Laboratory Memorandum No. 1, Beltsville, Md., 1952.

² Location: Mason County, Wash., SW^{1/4}SE^{1/4} sec. 23, T. 20 N., R. 4 W. (2.7 miles west of Shelton). Sample collected in open area that was cut over fairly recently.

BROWN PODZOLIC SOILS INTERGRADING TO GRAY-BROWN PODZOLIC SOILS

The soils in this group have bisequel profiles. Underlying the organic litter is a weak, thin A₁ horizon or a weak podzol B horizon, or both, over a textural B. There is no A₂ horizon. The podzolization is weakly expressed by the shot pellets that are higher in iron oxides than the surrounding soil.

All of these soils have formed from medium-textured, glacial lacustrine material varying only slightly in composition. They occur in association with the Brown Podzolic soils and have similar climate (12). The vegetation also is similar, but it is more dense and faster growing. In Mason County, the Cloquallum, Kitsap, Saxon, and Nordby soils are in this group.

Cloquallum series

The following profile of Cloquallum silt loam is representative of Brown Podzolic soils intergrading to Gray-Brown Podzolic soils. The vegetation is similar to that on the other zonal soils except that it is more dense and faster growing.

A₀₀ and A₀ 2 to 0 inches, very dark grayish-brown (10YR 3/2, moist), partly decomposed litter of needles, leaves, twigs, moss, fern fronds, and roots; pH 5.3; the lower part is darker colored and more highly decomposed, lower boundary smooth and abrupt.

B₂₁ or A₁ 0 to 9 inches, dark-brown (10YR 3/3, moist) to brown or pale-brown (10YR 5.5/3, dry) silt loam; strong, coarse, granular structure; friable, slightly hard, slightly plastic, and slightly sticky; few to moderate number of rounded shot pellets; numerous roots; pH 5.8; lower boundary clear and wavy.

B₂₁ 9 to 15 inches, silt loam that is brown or dark brown (7.5YR 4/3, moist) to reddish brown or dark reddish brown (5YR 3 5/4, moist) and light brown to brown (7.5YR 5 5/4, dry); moderate, medium to fine, subangular blocky structure; thin continuous films of clay on ped surfaces, firm, hard, slightly sticky, and slightly plastic; few rounded shot pellets; numerous roots, pH 5.7, lower boundary gradual and wavy.

B₂₂ 15 to 24 inches similar to B₂₁ horizon but has a few, faint, yellowish-red mottles and a brown to dark-brown (7.5YR 4/3, moist) color; texture is a heavy silt loam or silty clay loam; films of clay on ped surfaces are thicker than in B₂₁ horizon, pH 5.4; lower boundary gradual and wavy.

Hoodsport and Shelton series

The Hoodsport and Shelton soils have developed from mixed, compact, strongly cemented till deposited by the continental glacier. The till has been influenced by local drift from the Olympic Mountains, as well as by considerable basaltic rock of local origin. The Hoodsport and Shelton soils are most nearly similar to the Alderwood soils but have developed under a higher rainfall that ranges from 60 to 90 inches a year. The Hoodsport and Shelton soils have a thin, dark-colored A₁ horizon over a B_{tr} horizon containing many of the shot pellets common

in the Brown Podzolic soils. The A₂ horizon is absent in most places. The solum is more red than that of the Alderwood soils.

The Shelton soils differ from the Hoodsport soils in that they are more acid, less stony, and have been influenced less by basaltic materials. In addition, the cemented C horizon lies from 8 to 12 inches deeper in the soil. The Hoodsport soils occur at higher altitudes and have developed under slightly more rainfall than the Shelton soils.

Table 14 shows chemical and particle-size analyses of a Shelton soil.

analyses of Shelton gravelly sandy loam³

Base saturation	pH	Organic carbon	Size classes							
			Clay (less than 0.002 mm.)	International silt (0.02 to 0.002 mm.)	USDA silt (0.05 to 0.002 mm.)	Very fine sand (0.1 to 0.05 mm.)	Fine sand (0.25 to 0.1 mm.)	Medium sand (0.5 to 0.25 mm.)	Coarse sand (1 to 0.5 mm.)	Very coarse sand (2 to 1 mm.)
Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
31	4.8	5.0	12.8	27.3	40.9	9.0	13.6	7.4	8.6	7.7
54	5.4	2.52	13.7	26.7	39.7	9.2	13.1	7.5	8.8	8.0
18	5.3	.94	13.2	22.7	34.1	8.8	13.8	8.6	9.9	11.6
14	5.3	.57	11.5	20.6	31.5	9.3	14.6	9.4	11.9	11.8
22	5.4	.34	8.0	16.3	25.9	8.6	14.3	10.1	16.5	16.6
23	5.3	.28	7.2	14.6	24.1	9.1	14.2	10.0	16.5	18.9
37	5.2	.11	4.9	20.1	32.2	10.2	16.2	10.6	14.3	11.6
47	5.6									
	4.8									
24	5.1	7.1	12.2	27.4	43.8	10.2	11.1	4.7	7.9	10.1
14	5.3	5.4	12.4	27.1	43.2	9.9	10.6	4.5	8.0	11.4
7	5.2	2.46	11.9	25.9	42.4	10.7	11.6	5.2	8.9	9.3
6	5.4	1.40	11.8	22.8	36.3	9.5	10.1	5.0	10.4	16.9
6	5.6	.96	6.2	21.2	37.0	11.9	12.5	6.2	12.4	13.8
3	5.8	21	6.9	21.2	36.8	12.0	13.7	7.1	12.5	11.0

³ Layer 40 to 46 inches not sampled.

⁴ Location: Mason County, Wash., NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 10, T. 20 N., R. 5 W. (approximately 11 miles west of Shelton). Sample collected under Douglas-fir and lodgepole pine.

B₃ 24 to 32 inches, dark yellowish-brown (10YR 4/4) to pale-brown (10YR 6/3, dry) silt loam, many, distinct, yellowish-red mottles; weak, medium, subangular blocky structure, films of clay, thin and discontinuous, firm, slightly hard, slightly plastic, and slightly sticky, many roots; pH 5.3, lower boundary gradual and wavy

C 32 inches +, strongly laminated silt, silt loam, very fine sand, and silty clay loam, many, coarse, distinct gray, brown, yellowish-brown, and yellowish-red mottles, massive (structureless), firm, sticky, and slightly plastic, no clay films; pH 4.8.

Kitsap and Saxon series

The Kitsap and Saxon soils have developed from glacial lacustrine sediments. The parent material differs from the lacustrine-sediment parent material of the Cloquallum series in having been influenced less by basic materials. The Cloquallum soils occur in a higher rainfall belt. They differ from the Kitsap and Saxon soils in having a stronger structural development, a browner and more permeable profile, and in being more acid throughout.

The Kitsap and Saxon soils differ in that the Saxon

soil has a browner surface soil, a more permeable B₂ horizon, and less shot throughout. The Kitsap soils have numerous shot in the surface horizon.

Nordby series

The Nordby soils resemble the Cloquallum soils but differ in having more coarse gravel through the solum, and in having a weaker structural development and a weaker textural B horizon. The Nordby soils have developed from reworked local glacial lake sediments that have been modified by additions of basic igneous and metamorphic rock materials.

YELLOWISH-BROWN LATERITIC SOILS

This group was first defined in Puerto Rico (14), in regions of humid, tropical and subtropical climate where the annual rainfall was 50 to 80 inches. The soils have yellowish-brown, slightly acid, permeable, and friable surface horizons underlain by yellowish-brown to reddish-yellow, fine-textured but permeable and slightly acid subsoils. This group parallels that of Reddish-Brown Lateritic soils but is more yellow and less red in color throughout the profile.

The Astoria, Hoquiam, Delphi, Le Bar, Tebo, and Belle series in Mason County have been tentatively placed in the Yellowish-Brown Lateritic group. These soils have reddish-brown to dark-brown, thin, friable A₁ horizons with moderate to strong, granular structure. They have yellowish-brown to yellowish-red, fine-textured but permeable and friable B₂ horizons that are marked by moderate to strong grades of structure. The soils are medium to strongly acid throughout the profile. Soil materials in the deeper horizons tend to smear when rubbed between the fingers but are not sticky and plastic, despite a high clay content.

Some laboratory data are available for profiles of the Astoria and Hoquiam series outside of Mason County. According to these data,⁴ the soils have high cation-exchange capacities and base saturation of 15 percent or less, and they tend to become less acid with increasing depth. Quantities of "free" iron oxide remain essentially constant throughout the profile. The combination of high cation-exchange capacity with smeary consistence suggests the presence of allophane, although this has not been confirmed. Furthermore, the combined morphological and laboratory data indicate that these soils have some properties in common with the Latosols of humid regions (2), and with the Ando soils (17) derived from volcanic ash. At the same time, features such as the strong, subangular blocky structure and thin clay coats surrounding peds in the B₂ horizons are lacking in Latosols and Ando soils. All in all, it therefore seems best to classify these series in the Yellowish Brown Lateritic group, recognizing that they have some properties of Latosols and some of the Ando group.

The six series—Astoria, Hoquiam, Delphi, Le Bar, Belle, and Tebo—occur in the western part of the county where rainfall ranges from about 70 to more than 100 inches per year. Summers are comparatively dry; most of the precipitation comes in winter. The average annual temperature is approximately 50° F. The native vegetation consists of a very dense forest of Douglas-fir, hemlock, and cedar. The soils have formed in deeply weathered parent materials.

The soil series mentioned in the preceding paragraph—all classified as Yellowish-Brown Lateritic soils—have profiles similar to the following profile of Hoquiam loam.

A₁₀ and A₉ 2 to 0 inches, very dark grayish-brown, loose litter consisting of partly decomposed needles, leaves, twigs, moss, and roots; the lower part is more darkly colored, more decomposed, and mixed with some mineral matter; very strongly acid; lower boundary smooth and abrupt.

A₁ 0 to 3 inches, dark reddish-brown (5YR 3/4, moist) to reddish-brown (5YR 4/4, dry), heavy loam; strong, coarse, granular structure; friable, slightly plastic, and slightly sticky; many soft rounded shot; 15 percent of matrix is subangular gravel; numerous roots; strongly to very strongly acid; lower boundary clear and smooth.

A₂ 3 to 15 inches, reddish-brown (5YR 4/4, moist) to brown (7.5YR 5/4, dry), heavy loam; strong, medium, granular to subangular blocky structure; friable, slightly plastic, and slightly sticky; numerous, small, irregular, soft shot and many coated small pebbles having the appearance of shot; numerous roots; strongly to very strongly acid; lower boundary clear and wavy.

⁴ Unpublished data by V. J. KILMER, Soil Survey Laboratory, Soil Conservation Service, Beltsville, Md.

B₂₁ 15 to 34 inches, yellowish-red (5YR 4/8, moist) to yellowish-red (5YR 5/6, dry) loam to clay loam; strong, medium, subangular blocky structure; firm, hard, slightly sticky, and slightly plastic; many, soft, irregular shot, as in A₂ horizon; skins of clay thin and continuous on ped surfaces; many roots; strongly acid; lower boundary gradual and wavy.

B₂₂ 34 to 42 inches, yellowish-red (5YR 4/8, moist) to reddish-yellow (7.5YR 6/6, dry) loam to clay loam; strong, coarse, subangular blocky structure; friable to firm, hard, slightly sticky, and slightly plastic; few, irregularly shaped, soft shot; many roots; thin, continuous films of clay; strongly acid; lower boundary clear and wavy.

C 42 inches +, yellowish red (5YR 5/8, moist) to reddish-yellow (7.5YR 6 5/6, dry), strongly weathered gravel and clay; variable in color and texture; many, coarse, prominent mottles of red, yellow, gray, and dark brown; massive; firm; soft, weathered gravel and stone are mostly sandstone and shale, and the harder, less weathered material is mainly basic igneous rock; strongly acid.

Astoria series

These soils have formed from weathered shale and sandstone. The A₁ horizon is darker and the B₂ horizon is finer textured than that of the Hoquiam soils. In addition, the profile is more acid. The A₁ horizon is a dark-brown, friable silt loam with moderate, fine, granular structure. This layer grades to a B horizon of brown or yellowish brown, firm silty clay loam that has a moderate, fine, subangular blocky structure. As with the Hoquiam soils, the several horizons of the Astoria profile seem, when examined in the field, to be more silty than they actually are. This is a characteristic of both Latosols and Ando soils.

Tebo and Delphi series

The Tebo soils have formed mainly from basic igneous rock, but they were somewhat influenced by mixed glacial till. The Delphi soils have been strongly influenced by glacial material, and their profile is coarser than that of the Tebo soils. Delphi soils have a thin, weak A₁ horizon and a weak, friable, yellowish-brown, textural B₂ horizon. The Tebo soils also have a weak, reddish-brown A₁ horizon, which is underlain by a yellowish-red, moderately strong, clay loam, textural B horizon having a strong, blocky structure.

The Tebo and Delphi soils are less acid than the Hoquiam soils. They are moderately acid to strongly acid but become slightly less acid with depth. The Tebo soils change very little with depth; they are medium to strongly acid throughout. The substratum of the Delphi soils is medium acid.

Le Bar series

The Le Bar soils have developed from mixed, medium-textured terrace material that is underlain by compact gravelly material. They are most nearly similar to the Sol Duc soils but differ in being fairly free of gravel in the upper 3 or 4 feet. They also differ in having a moderate to strong, subangular blocky structure in the B horizon and in having a profile consisting of medium-textured material.

Belle series

The Belle soils occupy alluvial fans and terraces. They are well drained and have developed from mixed sediments that washed from Astoria and Hoquiam soils. The A_1 horizon of the Belle soils is a very dark grayish-brown, moderately granular silt loam; it is underlain by a weak, textural B horizon. The B horizon is friable and permeable, has a moderate, subangular blocky structure, and contains thin to moderate, continuous films of clay.

Intrazonal soils

The intrazonal soils in Mason County are in the Humic Gley, Low-Humic Gley, and Bog great soil groups.

HUMIC GLEY SOILS

Humic Gley soils are poorly drained hydromorphic soils. They are medium acid to slightly acid and have moderately thick, dark-colored, organic-mineral A horizons underlain by mineral gleylike horizons.

In Mason County, the Bellingham, McKenna, Norma, and Deckerville are Humic Gley soils. These soils occur in upland depressions, and they are saturated in winter and spring. The vegetation is a swamp forest. The A horizon in all of these soils is dark colored, and the B and C horizons have different textures. The horizons below the A are generally gray or olive gray and are distinctly mottled with yellowish brown, reddish brown, blue, green, brown, or yellow. The mottlings are the result of fluctuations in the water table and of the reduction, oxidation, and hydration of minerals that accompany such changes.

Bellingham and Norma series

The Bellingham soils have developed from glacial lake sediments similar to those of the Kitsap and Cloquallum soils. The Bellingham soils are generally free of pebbles and stones to depths of 2 to 4 feet.

The Norma soils have developed from sandy drift similar to that from which the somewhat excessively drained Indianola and Lystair soils have formed. Norma soils are more permeable than Bellingham soils, and their A_1 horizon is not so dark colored. The B horizon is medium to coarse textured and without films of clay. Weak orterde development occurs below the nearly black to very dark gray A_1 horizon.

Bellingham and Norma soils have developed under a dense growth of mixed deciduous and evergreen trees, brush, and water-tolerant vegetation. These plants have supplied large quantities of organic residue that has contributed to the high content of bases in the soils.

The Humic Gley soils can be represented by a profile of Bellingham silt loam, as follows:

A_1 0 to 8 inches, nearly black or black (10YR 2/1, moist) to very dark gray (10YR 3/1, dry) silt loam; moderate, medium, granular structure; friable, plastic, and sticky; high in organic matter; numerous roots; slightly acid to medium acid; lower boundary clear and smooth.

B_1 8 to 14 inches, very dark gray (10YR 3/1, moist) to dark-gray (10YR 4/1, dry) silt loam to silty clay loam; moderate, coarse, subangular blocky structure; firm, hard, plastic, and sticky; few to many distinct mottles of reddish brown and yellowish brown; thin patchy skins of clay on surface of ped; a few gray

coatings on surface of some ped; roots less numerous than in A_1 horizon; lower boundary abrupt and smooth.

B_{2g} 14 to 26 inches, gray (5Y 5/1, moist) to light-gray (5Y 7/1, dry) clay; many distinct, medium and coarse mottles of yellow, yellowish brown and reddish brown; moderate, medium, blocky or subangular blocky structure; thick continuous organic and clay skins on ped surfaces, firm, very hard, very plastic, and very sticky; roots only along vertical cleavage lines; lower boundary gradual and wavy.

C 26 inches +, gray (5Y 5/1, moist) to light-gray (5Y 7/2, dry) clay; few, faint to distinct mottles of yellowish brown and bluish gray; massive; very firm, very hard, very plastic, and very sticky; few roots along cleavage lines; below depths of 4 to 6 feet, horizon rests on laminated glacial lake sediment or on compact drift.

The soil is less acid with increasing depth; it is slightly acid to neutral at a depth of 36 inches.

McKenna and Deckerville series

Soils of the McKenna and Deckerville series differ from the Bellingham soil in that their parent material is gravelly drift and the B horizons are more coarsely textured and contain much gravel. The Deckerville soils differ from the McKenna soils in that the parent material contains more basic substances, the A horizon is darker colored, and the A and B horizons have stronger structural development.

Both the McKenna and Deckerville soils have very weakly developed B horizons. The B horizon of the McKenna soils usually has clay flows only in the pores. The Deckerville soils contain a gravelly clay loam B horizon that has patchy clay flows on ped surfaces and in pores. The McKenna soils occur in the 50- to 80-inch rainfall belt; the Deckerville soils are in the 70- to 100-inch belt.

LOW-HUMIC GLEY SOILS

The Low-Humic Gley soils are imperfectly to poorly drained and have very thin A horizons that are moderately high in organic matter. The A horizons are underlain by mottled gray and grayish-brown gleylike mineral horizons showing a low degree of textural differentiation. Low-Humic Gley soils have formed under swamp forest vegetation, and they normally are medium acid to strongly acid.

The Edmonds, Koch, and Stimson soils are Low-Humic Gley soils. They are grayish and have developed under restricted drainage. The A horizons are lighter colored and contain less organic matter than those of the Humic Gley soils.

Edmonds and Koch series

The Edmonds soils have developed from sandy glacial drift under poor drainage. They have a grayish-brown A horizon and a mottled, weakly podzolized B horizon. The weakly developed orterde below the A horizon in these soils gives them some of the characteristics of Ground Water Podzols.

The Koch soils have developed from gravelly drift under imperfect to poor drainage. They have a very dark gray A horizon that contains only a moderate amount of organic matter. The subsoil is distinctly mottled and very gravelly. These soils have A and C horizons but no B horizon.

The following profile of Koch gravelly loam is typical of the Low-Humic Gley soils of Mason County:

A₁ 0 to 6 inches, very dark gray (10YR 3/1, moist) to dark-gray (10YR 4/1, dry) gravelly loam; few, fine, faint mottles of dark yellowish brown; weak, fine and medium, granular structure; friable; numerous roots; pH 5.0; lower boundary abrupt and smooth.

AC 6 to 22 inches, very dark grayish-brown (10YR 3/2, moist) to dark grayish-brown (10YR 4/2, dry) gravelly or very gravelly coarse sandy loam; few, fine, distinct, very dark gray manganese stains and reddish-brown mottles; massive; firm and, in places, weakly to moderately cemented by manganese and iron; films of clay absent; many roots; pH 5.7; lower boundary gradual and wavy.

C_g 22 to 34 inches, dark grayish-brown (10YR 4/2, moist) very gravelly loamy coarse sand; many prominent mottles of reddish brown; gravel is stained with manganese and iron; massive; compact in place, but loose when removed; very few roots; pH 5.7; lower boundary gradual and wavy.

C 34 inches +, gray, dark-gray, and dark grayish-brown gravelly sand or sandy gravel; few, faint mottles of reddish brown; gravel less stained than in C_g horizon; massive; loose when removed; pH 6.0.

Stimson series

The Stimson soils have developed in low-lying, poorly drained areas in association with the well-drained Hoquiam soils. The parent materials are similar. The Stimson soils have a thin A horizon, moderately high in organic matter, that is underlain by a fine-textured gley-like horizon mottled with grayish brown. The Stimson soils differ from the Bellingham soils in parent material and in having a much thinner and lighter colored A horizon.

BOG SOILS

The Bog soils have a muck or peat surface layer that is underlain by peat. They occur in deep depressions and low basins in which the water table is high most of the year. They were derived from the organic remains of swamp or marsh-type vegetation that is in various stages of decomposition. The profile of a normally developed Bog soil shows the remains of the successive kinds of plants that grew in the area. In ascending order, the first kind of plant remains is that of aquatic plants that formed highly colloidal or sedimentary deposits. This is followed by remains of sedges, reeds, and other water-loving plants that formed a very fibrous, organic deposit. The final plant remains are those of water-tolerant brush, shrubs, and characteristic trees of a swamp forest. Sphagnum or other mosses may have followed any of the plant stages if bases were exhausted and acid conditions prevailed—a condition that other plants could not tolerate.

In Mason County, Tanwax peat has developed mainly from aquatic vegetation that grew in open water. Semiahmoo muck and Mukilteo peat have developed from sedges and reeds that grew in open marshes. Tacoma peat is a sedge peat that has developed mainly from salt-tolerant vegetation. McMurray peat has developed from water-tolerant swamp and forest vegetation. Orcas peat has developed mainly from sphagnum and other mosses.

Peat is organic soil in which plant remains can be identified in the 6- to 12 inch surface layer. It is partly decomposed fiber and mottled material. Muck is organic soil in which the plant remains are well decomposed and

cannot be readily identified in the 6- to 12-inch surface layer. Semiahmoo muck was the only muck recognized in Mason County. However, peat soils quickly decompose to muck when they are drained and cultivated.

Azonal soils

Azonal soils lack distinct, genetically related horizons because of their youth, resistant parent material, or steep topography. In Mason County, the Ando and Alluvial soils belong to this order.

ALLUVIAL SOILS

The Alluvial soils consist of deep alluvium or soft mineral deposits, in which few or no clearly expressed soil characteristics have developed. The soils are forming on several different parent materials. Differences in their morphological characteristics have been brought about by differences in parent materials and drainage. Members of this great soil group are the Eld, Dungeness, Juno, Pilchuck, Skokomish, Belfast, Wadell, Maytown, Puget, Nuby, and Wapato soils.

The Pilchuck, Dungeness, Skokomish, and Puget soils are developing from parent materials derived from a similar source. However, these soils differ in texture and degree of drainage. The parent materials originated largely from quartzite and slate, mixed with some basic igneous and other materials. A catenary relationship exists among the somewhat excessively drained Pilchuck, the moderately well drained Dungeness, the imperfectly drained Skokomish, and the poorly drained Puget soils.

The Pilchuck soils occupy the frequently flooded first bottoms and consist of fine and coarse sands and gravel. They are light brownish gray and gray and have developed no genetic horizons. The Dungeness soils are elevated from the area annually flooded, but they occupy most of the alluvial bottom lands. The surface soil is mainly silt loam and fine sandy loam, brown to dark brown when moist and weakly granular and very friable. The subsoil, coarse but only slightly lighter colored than the surface soil, is more stratified with depth and is faintly mottled below a depth of 30 inches. The Skokomish soils are friable, weakly granular, and imperfectly drained. They generally have a dark grayish-brown surface soil than can range from gray to dark brown within a short distance. The subsoil is grayish-brown to dark grayish-brown, mottled silt loam or silty clay loam that is massive and shows no skins of clay. These three soils may have gleyed and weakly developed A₁ horizons; consequently, they are intergrading to the Low-Humic Gley soils.

The Puget soils are similar to the Skokomish soils but are grayer, more mottled, and poorly drained. The Puget soils also have some characteristics of the Low-Humic Gley soils.

The Eld, Maytown, and Wapato soils occur on the bottom lands of streams and rivers that originate in the Black Hills and in the Olympic Mountains. The parent material of these soils originated mainly from basic igneous rock, sandstone, and shale. The Maytown and Eld soils are moderately well drained, and the Wapato soils are poorly drained. All of these soils have very weakly developed A horizons underlain by subsoils that have thin, patchy skins of clay on ped surfaces. The

Wapato soils have weakly developed, gleyed characteristics like those of the Low-Humic Gley soils.

The Juno, Belfast, and Nuby soils occur mainly along the small streams originating in glacial uplands. The parent materials consist mostly of reworked glacial material. The Juno soils are shallow and somewhat excessively drained. They have loose, porous, very coarse material within 1 to 2 feet of the surface. The Belfast soils are deeper than the Juno, are moderately well drained, and are not so porous as the Juno soils. Except for weakly developed A horizons, soils of neither of these series have distinct genetic horizons. The Nuby soils are poorly drained to somewhat poorly drained. Their profiles are gray; the subsoil is distinctly mottled.

The Wadell series occurs on alluvial fans. It consists of well-drained soils that are developing from basic igneous alluvium. The profiles are very weakly expressed. The surface soil is dark reddish brown when moist, and the A₁ layer is slightly darker than the rest of the surface soil. The subsoil shows thin, patchy films of clay on ped surfaces. The Wadell soils have some of the characteristics of the Reddish Brown Lateritic soils.

ANDO SOILS

This group of soils is marked by dark A₁ horizons commonly about 1 foot thick, that grade through transitional horizons of equal or lesser thicknesses to the lighter colored parent materials. Evidence of clay accumulation in the B horizons is generally lacking. The soils are strongly acid, low in base saturation, and high in organic-matter content. They have a high carbon-nitrogen ratio. For the most part, known representatives of this group have been derived from volcanic ash or from parent materials that included a substantial component of volcanic ash.

Among the soils in Mason County, the Carstairs and Nasel series have tentatively been placed in the Ando group, although evidence for such classification is far from conclusive. Another possibility would have been to classify the two series as Regosols, but this seems unwise for soils that have such prominent A₁ horizons. A third possibility would be to classify the soils as transitional between true Chernozems and the more weakly podzolized meadow soils of forested regions, as was suggested by Nikiforoff (12) after study of similar soils in western Washington a number of years ago. Tentative classification of the two series as Ando soils is based on their strong acidity, the prominent A₁ horizons, the sootiness of the organic matter, and the lack of any horizons of carbonate accumulation.

The Carstairs and Nasel soils were formed in prairie areas under scattered trees and shrubs. The present vegetation on the Nasel soils is mainly Douglas-fir, which has encroached rapidly on the prairie in recent years.

The following profile description of Carstairs gravelly loam represents the Ando group in this county.

A₁ 0 to 9 inches, black (10YR 2/1, moist) to very dark gray, (10YR 3/1, dry) gravelly loam; moderate, fine, granular structure, friable, nonsticky, nonplastic, very sooty, and smeary; numerous roots in the upper 6 inches, pH 5.0; lower boundary gradual and wavy.

AC 9 to 14 inches, dark reddish-brown (5YR 2/2, moist) to reddish-brown (5YR 4/3, dry) gravelly loam; weak, coarse, granular structure; friable, but firm or very weakly cemented in lower 2 inches; nonplastic and nonsticky, many roots, pH 5.4; lower boundary clear and wavy.

C 14 inches+, mixed dark yellowish-brown, grayish-brown, gray, and dark-gray, loose sandy gravel, single-grained; gravel is slightly stained with reddish brown, layer many feet thick.

The Nasel soils are similar to the Carstairs soils but differ from them in having a dark reddish-brown A₁ horizon and a brown gravelly loam AC horizon, which is underlain by a compact gravelly C horizon. The Nasel soils are moderately deep and medium textured. The Carstairs soils, in contrast, are shallow, loose, and sandy and gravelly.

Agriculture

Mason County is not important agriculturally, because it lacks large areas of naturally fertile soil, has insufficient rainfall for crops during summer, and is covered by dense forests. The main occupation has always been the production of forest products. Settlement is encouraged by good climate, favorable natural recreational facilities, and steady employment through sustained-yield forest management.

Most of the farmed acreage is on bottom-land soils where moisture is not readily available in summer. More land is in hay than in any other crop.

Land Use

The 1954 census reported that 46,974 acres, or 7.6 percent, of Mason County was in farms. Land in farms was distributed as follows:

Cropland, total	9,153
Cropland harvested	4,404
Cropland used only for pasture	4,293
Cropland not harvested and not pastured	456
Woodland, total	32,350
Woodland pastured	10,894
Woodland not pastured	21,456
Other pasture (not cropland and not woodland)	2,892
Improved pasture	352
Other land (house lots, roads, wasteland, etc)	2,579

In 1954 there were 526 farms in Mason County, and the average farm contained 89.3 acres. About 39 percent of farms contained 29 acres or less; about 35 percent, from 30 to 99 acres; and the rest, 100 acres or more. Only 9 farms in the county contained 500 acres or more in 1954.

In the past, uncleared land was cheap and could be obtained in large acreages for little money. Usually more than 90 percent of the price of the cleared land was for the clearing.

Type of Farm, Tenure, and Equipment

About 85 percent of the farms reported in the 1954 census are classed as miscellaneous and unclassified farms. Most of these raise products primarily for use of the farm household. The rest are classed as dairy, livestock, fruit-and-nut, poultry, and general farms. No farms were classed as field-crop farms or vegetable farms.

About 94 percent of the farms are operated by owners; the rest, by tenants. Most of the large farms are well equipped with tractors, trucks, and other farm machinery. A number of the small farms use horses. Seasonal labor is hired for harvesting grapes and berries. Large num-

bers of school children are employed to harvest berries, which ripen during the summer vacation.

Crops

Most farm crops are fed to livestock, but additional hay and grain is usually purchased from areas outside the county at fairly high prices. Additional acreage for hay and feed crops would benefit Mason County. The yields from many soils are low, compared to those from intensively farmed regions, but they could be improved through better management and the use of fertilizer, crop rotations, and green-manure crops.

The acreage of the principal crops and the number of bearing fruit and nut trees and grapevines are given in table 15.

TABLE 15.—*Acreage of the principal crops and number of fruit and nut trees and grapevines of bearing age in stated years*

Crop	1939	1949	1954
Corn, for all purposes	34	10	14
Oats threshed	58	107	105
Wheat threshed	29	1	5
Barley threshed	(1)	14	3
Land from which hay was cut	4,317	4,029	3,835
Clover and mixtures of clover and grasses cut for hay	1,445	1,892	2,081
Alfalfa	7	(1)	34
Wild hay cut	377	662	654
Oats, wheat, barley, rye, or other small grain cut for hay	1,602	578	288
Other hay cut	723	705	368
Grass silage from grasses, alfalfa, clover, or small grain	(1)	193	410
Irish potatoes harvested for home use or for sale	58	23	29
Vegetables harvested for sale	29	19	11
Strawberries harvested for sale	24	10	6
Raspberries (tame) harvested for sale	6	16	7
Apple trees	5,878	4,323	2,154
Peach trees	106	203	209
Pear trees	872	792	408
Plum and prune trees	1,418	899	461
Cherry (sour and sweet) trees	1,524	841	443
Grapevines	67,027	72,877	98,055
Filbert and hazelnut trees	392	2,984	1,309

¹ Not reported.

² Does not include acreage for farms with less than 10 bags harvested.

³ One year later than year at head of column.

Hay is harvested from about 42 percent of the cropland in the county. Most of the hay is clover, or mixtures of clover and timothy. The rest is mainly grass and grain hay. Mixtures of clover and ryegrass, or clover and alta fescue, are becoming more popular with farmers. Both red and alsike clovers are grown, but alsike is better suited to moist lowlands or to soils with imperfect drainage. In western Washington, the same field pre-

ferably should be used for both hay and pasture, as this gives greater flexibility in management and longer life to the forage plants (6).

Grass, clover, or mixtures of grass and clover are seeded as early in spring as a good seedbed can be prepared. Late in February, March, or early in April is the best time. Grain or grain-legume mixtures are also seeded as early as possible in spring. If seeded in fall, they are seeded as early as the fall rains allow. Grasses can be seeded in fall without harm, but clovers are susceptible to winterkill unless seeded by the first of September. If oats, or wheat, or a grain-legume mixture is used as a nurse crop, the grass and clover are seeded in fall. This is usually undesirable because the grass and clover then grow only a limited amount the first year. Grass and clover seeded properly and early enough usually grow enough for a cutting of hay the first year. Alfalfa is not commonly grown in Mason County. It does not grow well on the poorly drained soils, and the well-drained upland soils are often too dry for it.

Oats are the only important cereal crop grown; the area used for this crop has been fairly constant for the past 25 years. Oats mature more rapidly than other grains, and this is a distinct advantage where dry summers prevail. Oats are seeded early in spring to allow them to mature before dry weather arrives.

Fruits and nuts are fairly unimportant. The largest acreage of tree fruit is in apples, but the acreage has decreased in the past 25 years. Fruits are generally grown in small orchards for household use, or for local trade. The acreage in filberts and peaches has been increasing in the past few years, but the total area is still fairly small. Both are grown mainly for market and may become more important crops in the future. The trees should be planted on fairly deep, well-drained soils that have a fairly good capacity to hold available moisture. The Kitsap and Cloquallum soils are good for filberts and peaches.

The principal varieties of tree fruits and nuts grown in Mason County are:

Apples—Golden Delicious, Yellow Transparent, Early McIntosh, Milton, Wealthy, King, and Spitzenburg.

Pears—Bartlett, Anjou, Comice, and Winter Nelis.

Peaches—Lawrence, Rochester, and Veteran.

Sweet cherries—Royal Ann (Napolean), Bing, Lambert.

Sour cherry—Montmorency.

Filberts—Barcelona, Du Chilly, Daviana, Alpha, Gasaway, and Clackamas.

The Barcelona and Du Chilly filberts are the best varieties, but the Du Chilly is probably best adapted to Mason County climate and soil. The Du Chilly is a good pollenizer for the Barcelona, but the reverse is not true. Good pollenizers for the Du Chilly are the Daviana, Alpha, Gasaway, and Clackamas (15).

Grapes for wine are an important crop in the county. They are grown on the border of Pickering Passage and Case Inlet and on Stretch and Hartstene Islands. From the time the first commercial vineyards were established in 1890, the acreage has steadily increased to the present time. The rolling land adjacent to Puget Sound, where the grapes are grown, is well-suited to this crop because it is protected from local frosts that come late in spring

and early in fall. Grapes do not require large amounts of moisture, and they are not heavy feeders on plant nutrients. However, nitrogen and phosphate fertilizers have improved yields. Nitrogen is usually added through use of green-manure crops, and phosphate is applied to the green manure. Some farmers use a complete fertilizer, and others have obtained good results by applying potash to the green-manure crop.

The principal variety of grape is the well-adapted Campbell Early (Island Belle), which was developed in this area. Most of the white grapes do not ripen well, nor is there as good a market for them. Late plantings of the White Diamond variety show promise. Plants of this variety sprout rather late, but they mature about the same time as the Campbell Early. Several good wineries are located in the grape area. Yields vary because of climatic conditions. The average yield over a period of years is about 4½ tons per acre, or a little less. Yields of 8 tons per acre have been reported in some years.

Berry culture has increased somewhat because of high prices during and after World War II. The acreage is still quite small. Some loganberries and raspberries are grown for wine in the grape area, and other plantings are scattered here and there.

Interest in blueberries has increased, and several small plantings have been made. The common practice is to grow blueberries on strongly acid, poorly drained soils. Those planted on the well-drained soils in a few areas have also grown well. The bushes are less vigorous, but yields are high and of good quality. Blueberries likely will grow on soil if their cousins, the huckleberries, are growing there. Huckleberries grow well on the upland hardpan soils such as those of the Alderwood, Shelton, and Sinclair series. They grow best on Sinclair soils. Whether or not the correlation between growth of huckleberries and blueberries will hold in this area remains to be seen, but it appears that too much emphasis has been placed upon the need of growing blueberries under extremely acid and poorly drained conditions. Blueberry varieties adapted to Mason County are the Weymouth, Concord, Stanley, Rancocas, and Jersey.

Permanent Pasture

Permanent pastures together with woodland and partially cleared woodland furnish most of the livestock feed. Permanent pastures generally are in poorly drained and imperfectly drained upland depressions and on well-drained and imperfectly drained alluvial flood plains. Well-drained upland soils are usually too dry in summer for permanent pastures, and the very poorly drained flood plain and bottom land soils are suited only if special grasses are grown. Land in permanent pasture is farmed with land in hay, and, too often, the pastures are in poor condition. High yields of forage can be maintained through good management and the use of fertilizer and properly seeded, suitable plant mixtures. Barnyard manure applied with phosphate improves permanent pastures.

Three types of plants are needed for a good pasture (7): Sod-forming grasses, upright growing grasses to occupy the space overhead, and well-adapted clover to thicken the stand and add feeding value. Pastures should be seeded as early in spring as the soil can be worked and a good seedbed can be prepared. Cutover land should be seeded in February when the soil has been loosened by frost.

Land that is under water most of the winter, and not suitable for general farming, is particularly adapted to reed canarygrass, which makes good pasture with a high carrying capacity. The land can be seeded any time when the ground is dry enough to work, but early summer or spring seeding is best.

Livestock and Livestock Products

The number of livestock in the county in stated years is given in table 16. Cattle are mainly of the dairy breeds. Their number has steadily increased in contrast to the number of other livestock. Poultry and hogs are also important in the farming economy of Mason County.

TABLE 16.—Number of livestock on farms in stated years

Livestock	1940	1950	1954
Cattle and calves	¹ 3,615	4,198	5,514
Horses and mules	¹ 425	253	136
Hogs and pigs	² 383	322	239
Sheep and lambs	³ 140	84	88
Chickens	² 24,607	² 16,957	² 15,212

¹ Over 3 months old

² Over 4 months old

³ Over 6 months old

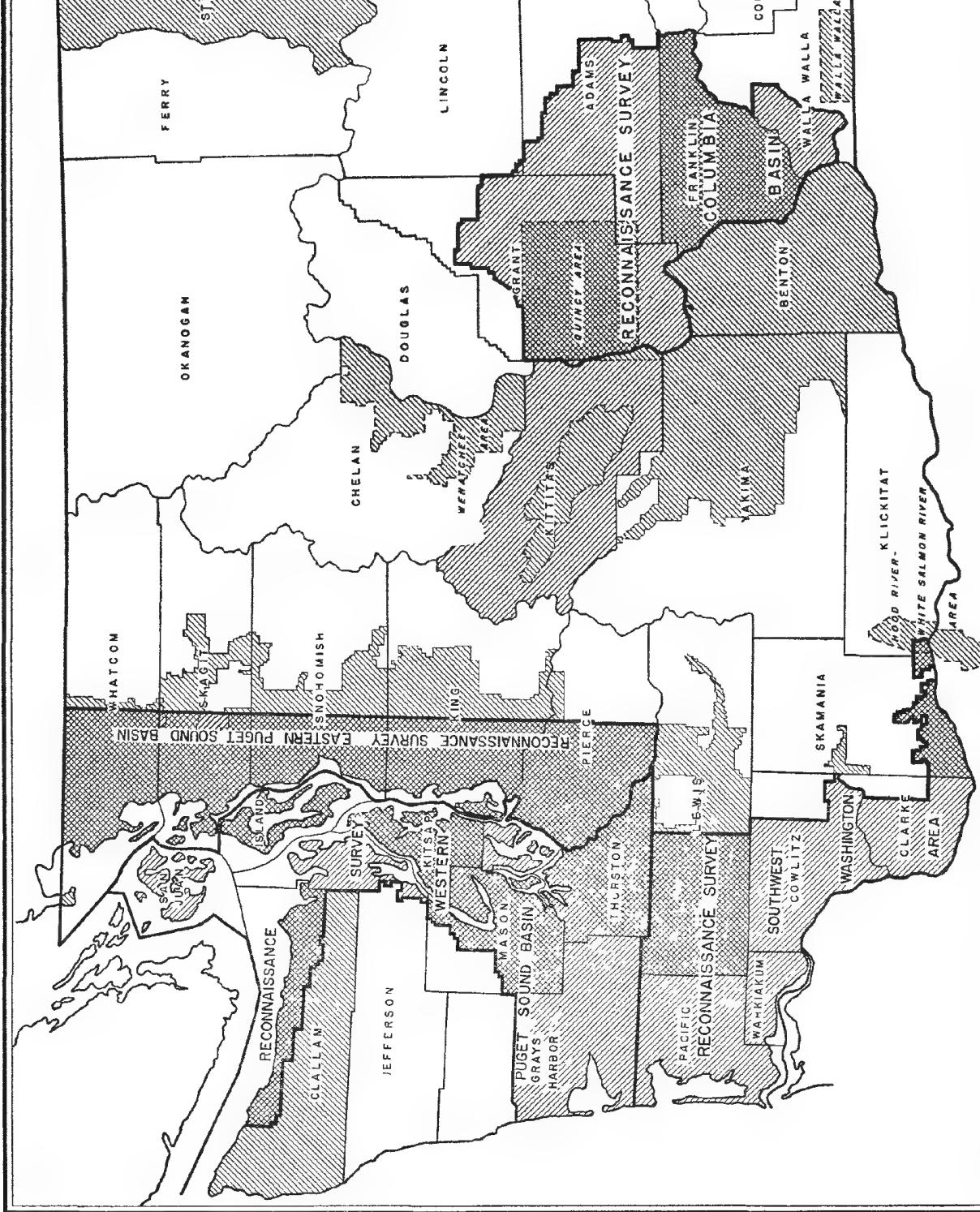
Most farms have dairy cattle. Subsistence farms usually have one or two Guernseys or Jerseys. The greatest numbers of cattle are on the lowland soils that are most suitable for hay and pasture. There are many excellent dairy herds in the county that produce high yields of butterfat. The main breeds of dairy cattle are the Guernsey, Holstein, and Jersey. Cooperatives and other companies offer a ready market throughout the dairy areas. They have processing plants in Shelton, Bremerton, and Olympia. The dairy industry is favored by cool summers, mild winters, few annoying insects, and long grazing seasons.

Much of the cattle feed is purchased outside the county. This is made necessary partly by the low acreage of improved land per farm, by the large number of the small subsistence farms that do not grow feed crops, and by poor management of meadows and pastures.

Beef cattle are raised mainly in the outlying parts of the county where they range over large areas. The largest number of cattle is raised around Matlock. The better cattle are of the Hereford breed. Good herds are difficult to maintain because most farmers use low-class bulls. A large number of grade cattle are raised. Herds could be improved through the use of better bulls.

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Areas surveyed in Washington: Reconnaissance surveys shown by northwest to southeast hatching; detailed surveys by northeast to southwest both ways, by crosshatching.

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MASON COUNTY, WASHINGTON - SHEET NUMBER 10

(Joins sheet 6)

R. 3 W. | R. 2 W.

10

N

(Joins sheet 9)

(Joins sheet 11)

T. 21 N. - T. 22 N.



MASON COUNTY, WASHINGTON - SHEET NUMBER 11

R. 2 W. | R. 1 W.

(Joins sheet 7)

11

(Join sheet 10)

T. 21 N., | T. 22 N.

(Joins sheet 15) | (Joins sheet 16)

9

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MASON COUNTY, WASHINGTON - SHEET NUMBER 12

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FOREST

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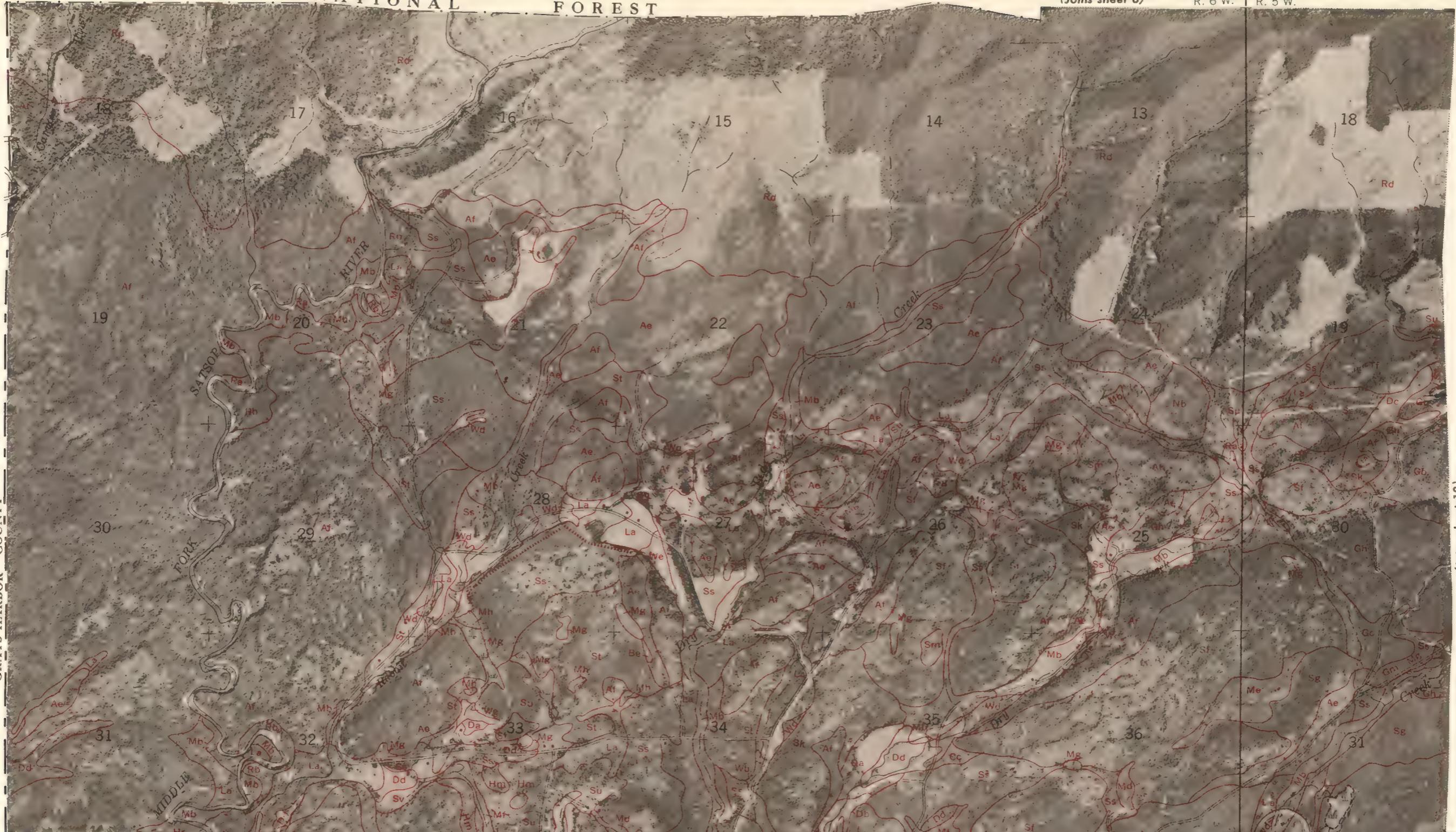
R. 6 W.

R. 5 W.

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GRAYS HARBOR COUNTY



(Joins sheet 13)

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Scale 1:31680

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(Joins sheet 17)

MASON COUNTY, WASHINGTON - SHEET NUMBER 13

(Joins sheet 8)

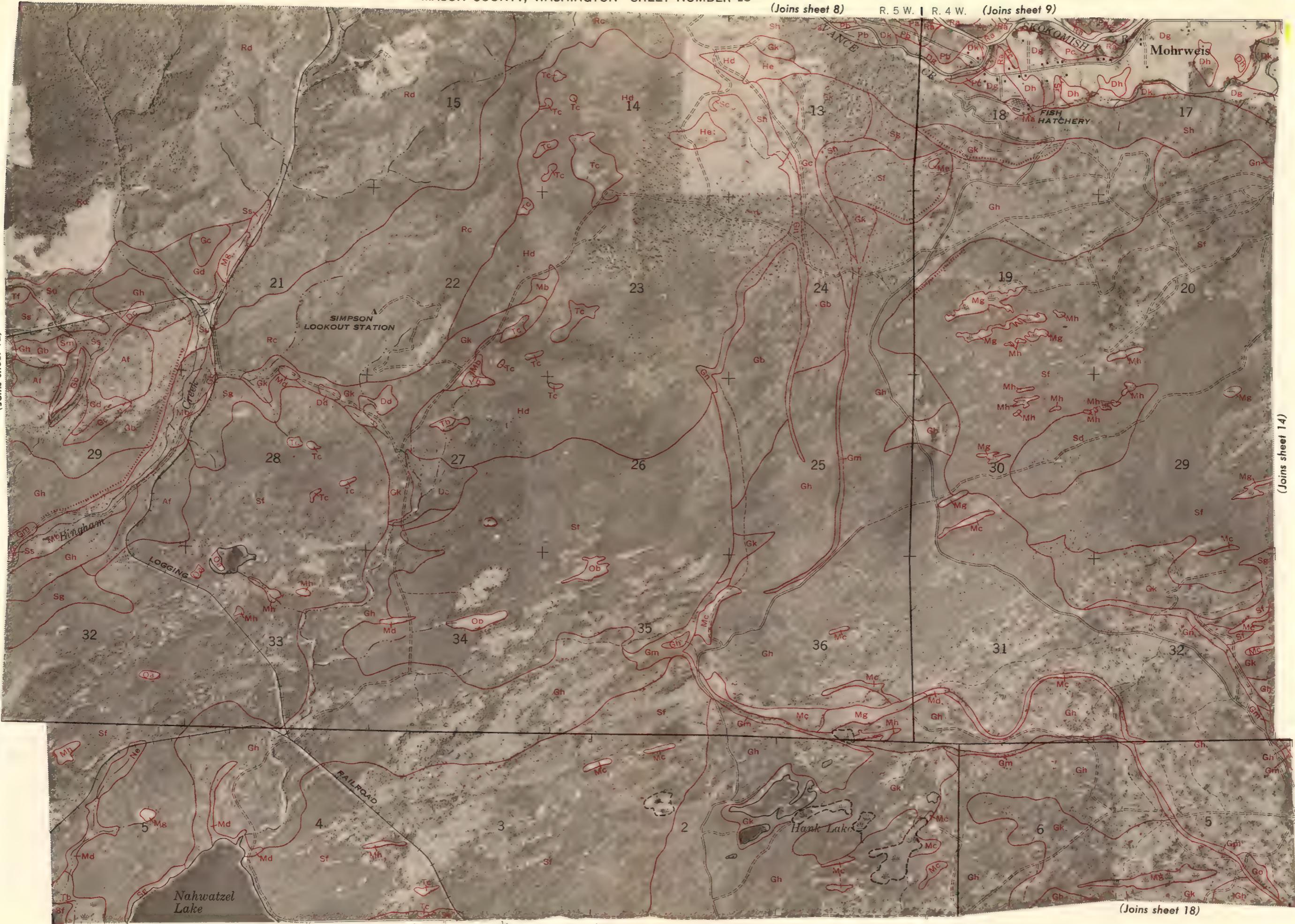
R. 5 W. | R. 4 W.

(Joins sheet 9)

13

(Joins sheet 12)

T. 20 N. | T. 21 N.



MASON COUNTY, WASHINGTON - SHEET NUMBER 14

14



(Joins sheet 19)

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MASON COUNTY, WASHINGTON - SHEET NUMBER 15 (Joins sheet 10) | (Joins sheet 11)

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(Joins sheet 14)

T. 20 N. I T. 21 N.

(Join sheet 16)

MASON COUNTY, WASHINGTON - SHEET NUMBER 18

18

(Joins sheet 13)



MASON COUNTY, WASHINGTON - SHEET NUMBER 19

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(Joins sheet 18)

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(Joins sheet 14)

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Join sheet 20)

(Joins sheet 23)

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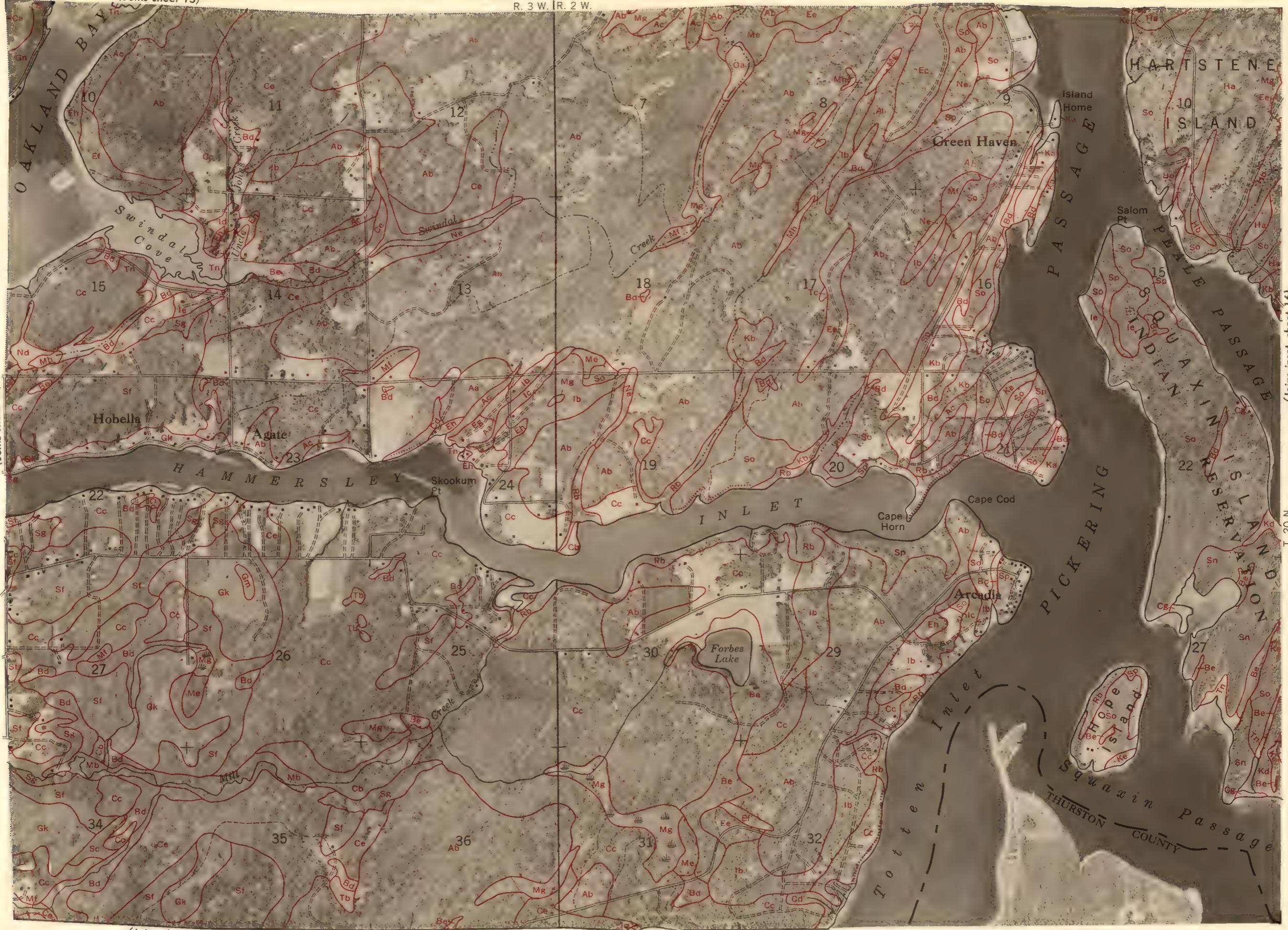
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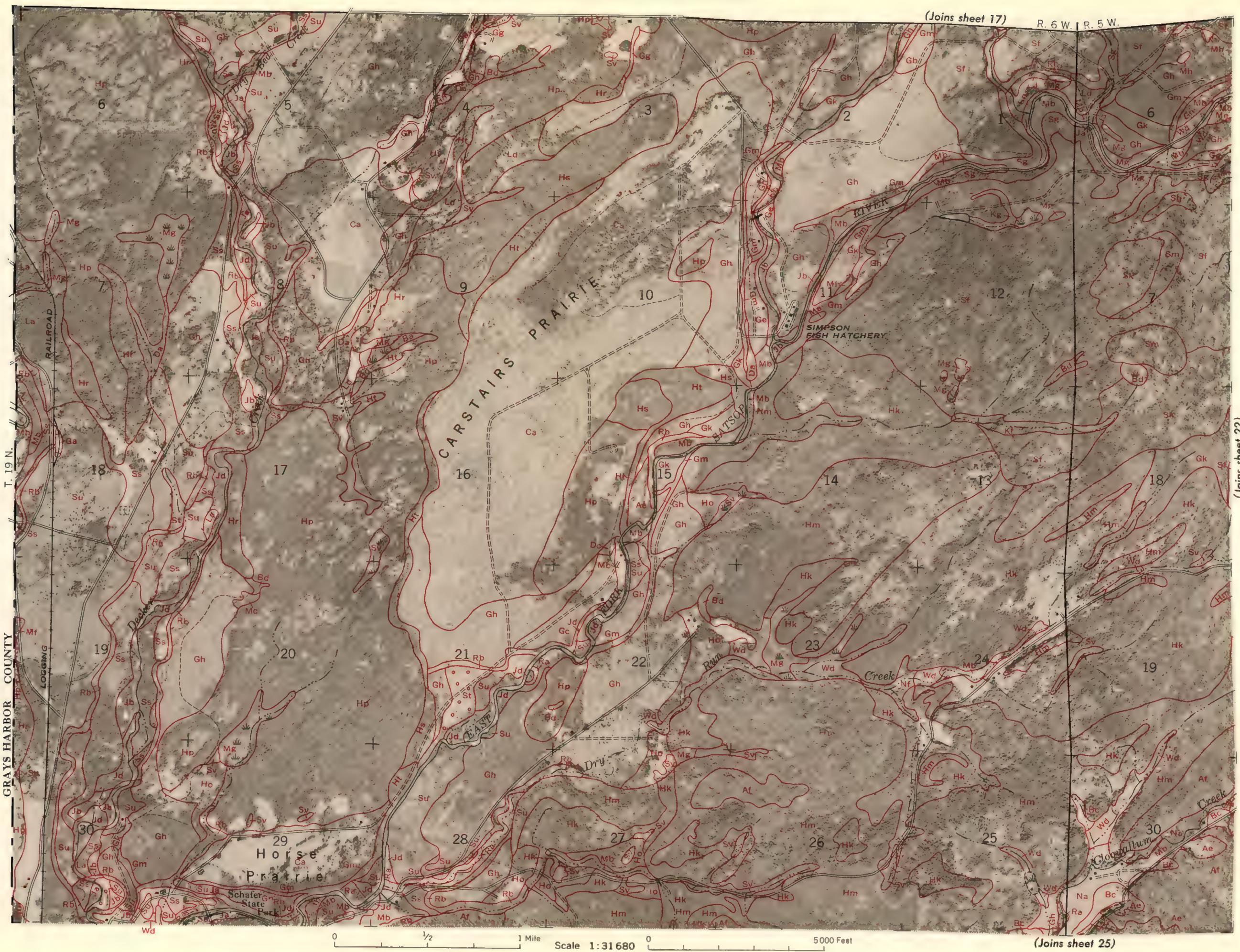
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MASON COUNTY, WASHINGTON - SHEET NUMBER 21



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(Join sheet 21)

Join sheet 23)

T. 19 N



MASON COUNTY, WASHINGTON - SHEET NUMBER 23 R. 4 W. | R. 3 W.

(Joins sheet 19)

23



MASON COUNTY, WASHINGTON - SHEET NUMBER 24

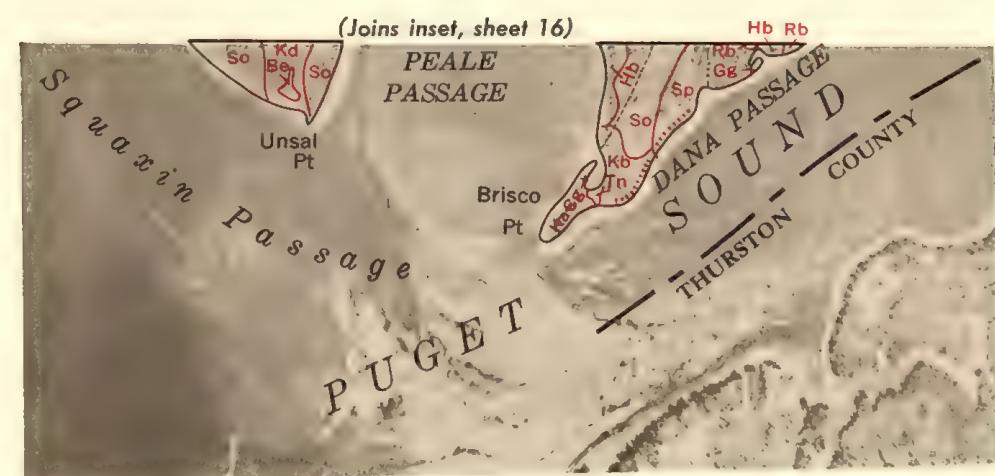
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(Joins sheet 20)

24

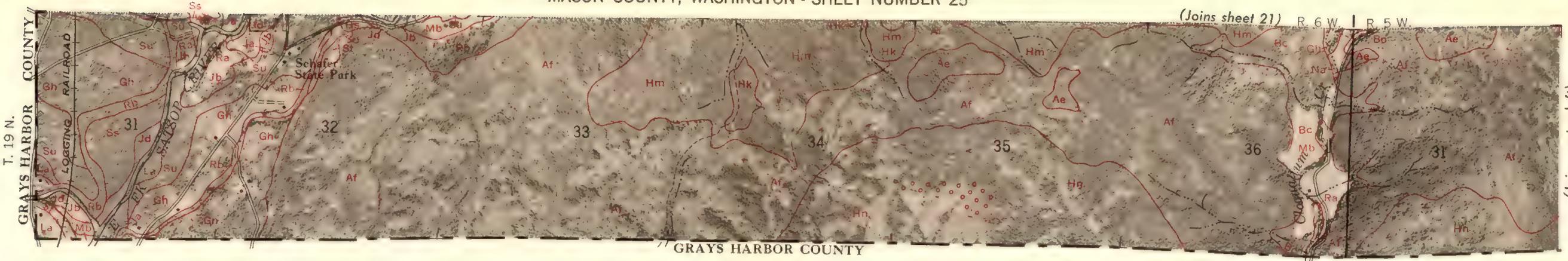
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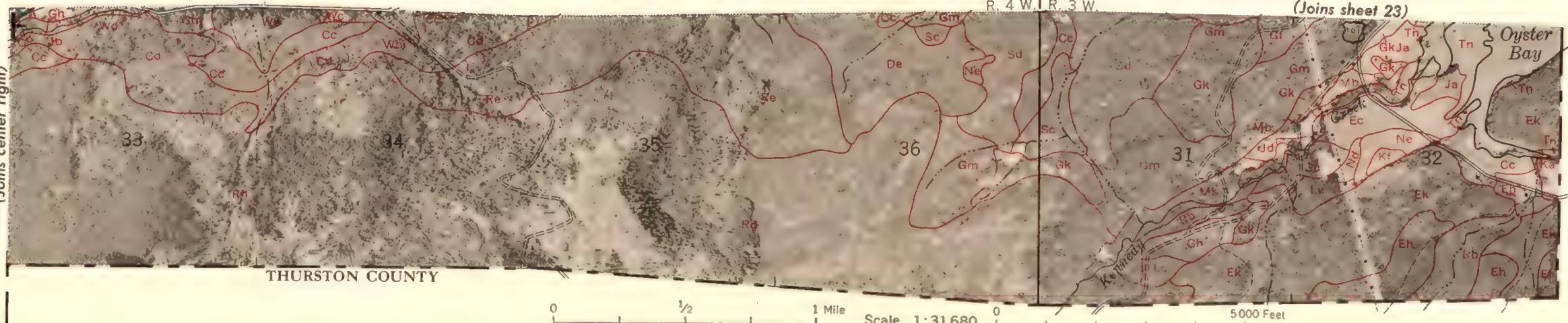
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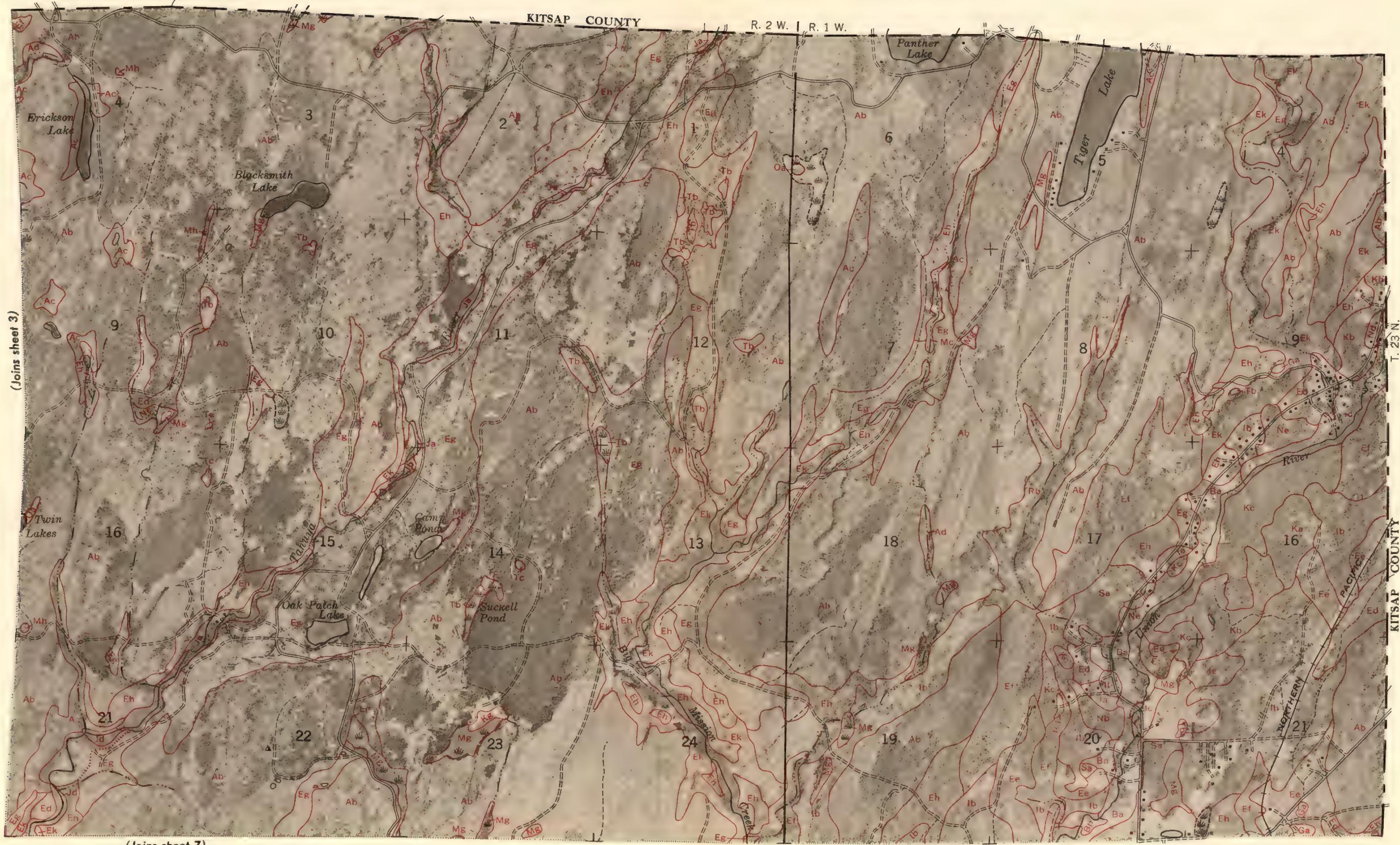
MASON COUNTY, WASHINGTON - SHEET NUMBER 3

3

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(Joins sheet 7)

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MASON COUNTY, WASHINGTON - SHEET NUMBER 5

(Joins sheet 2)

R. 4 W. | R. 3 W.

Lillianup
Bay

5

T. 22 N. | T. 23 N.
NATIONAL FOREST | ~~BOUNDRY~~

T. 22 N. | T. 23 N.
~~FOREST~~

OLYMPIQUE

C U S H M A N

Rd L L H 31

C U S H
Rd 6

A map section showing a river (Rd) and a gully (Gk). The river is labeled 'Rd' and the gully is labeled 'Gk'.

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(Join sheet 6)

(Join sheet 9)

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R. 3 W. | R. 2 W.

(Join sheet 5)

This geological map shows the distribution of various rock units across a terrain. Key features include:

- Units labeled:** Bay, Rb, Eh, Cc, Ab, Eg, Rb, and a dashed line labeled "Devonian".
- Numbered Locations:**
 - Location 33 is marked with a dashed line and the number 33.
 - Location 34 is marked with a dashed line and the number 34.
- Other Labels:** "Little" is written near the Eg unit, and "Devonian" is written near the dashed line.

This geological map shows the northern Boundary Waters Canoe Area. Key features include Aldrich Lake, Robbins Lake, U Lake, Clard Lake, and Cady Lake. Geologic units are labeled with abbreviations: Rb, Ac, Ab, Mh, and Mn. A horizontal line is drawn across the map, and the area is divided into numbered zones: 5 (Robbins Lake area), 4 (U Lake area), and 3 (Cady Lake area). A dashed line indicates a boundary or contact between different geological units.

This figure is a topographic map with contour lines. It includes several labels and symbols:

- Topographic Features:** Lone Duck Pond, Creek.
- Labels:** Rb, Ab, Ac, Ad, Eh, Ek, 8, 9, 10.
- Contour Lines:** Red lines representing elevation levels.

-Ac-
Join sheet 10

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MASON COUNTY, WASHINGTON - SHEET NUMBER 7

R. 2 W. | R. 1 W.

(Joins sheet 4)

7



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Q L Y M P I C N A T I O N A L F O R E S T



MASON COUNTY, WASHINGTON - SHEET NUMBER 9

R. 4 W. | R. 3 W. (Joins sheet 5)

9



SOIL LEGEND

SYMBOL	NAME	SYMBOL	NAME	SYMBOL	NAME
Aa	Alderwood gravelly loam, 5-15 percent slopes	Ha	Harstine gravelly sandy loam, 5-15 percent slopes	Nc	Nordby loam, 5-15 percent slopes
Ab	Alderwood gravelly sandy loam, 5-15 percent slopes	Hb	Harstine gravelly sandy loam, 15-30 percent slopes	Nd	Norma sandy loam, 0-3 percent slopes
Ac	Alderwood gravelly sandy loam, 15-30 percent slopes	Hc	Hoodsport gravelly sandy loam, 0-5 percent slopes	Ne	Norma silt loam, 0-3 percent slopes
Ad	Alderwood gravelly sandy loam, 30-45 percent slopes	Hd	Hoodsport gravelly sandy loam, 5-15 percent slopes	Nf	Nuby silt loam, 0-3 percent slopes
Ae	Astoria silt loam, 5-15 percent slopes	He	Hoodsport gravelly sandy loam, 15-30 percent slopes	Oa	Orcas peat, 0-2 percent slopes
Af	Astoria silt loam, 15-30 percent slopes	Hf	Hoodsport gravelly sandy loam, 30-45 percent slopes	Ob	Orcas peat, shallow over gravel, 0-2 percent slopes
Ba	Belfast sandy loam, 0-3 percent slopes	Hg	Hoodsport stony sandy loam, 5-15 percent slopes	Pa	Pilchuck gravelly loamy sand, 0-3 percent slopes
Bb	Belfast silt loam, 0-3 percent slopes	Hh	Hoodsport stony sandy loam, 15-30 percent slopes	Pb	Pilchuck loamy sand, 0-3 percent slopes
Bc	Belle silt loam, 0-5 percent slopes	Hk	Hoquiam gravelly silt loam, 5-15 percent slopes	Pc	Pilchuck sand, shallow, 0-3 percent slopes
Bd	Bellingham silt loam, 0-3 percent slopes	Hm	Hoquiam gravelly silt loam, 15-30 percent slopes	Pd	Puget silt loam, 0-2 percent slopes
Be	Bellingham silty clay loam, 0-3 percent slopes	Hn	Hoquiam loam, 15-30 percent slopes	Ra	Riverwash, 0-3 percent slopes
Ca	Carstairs gravelly loam, 0-5 percent slopes	Ho	Hoquiam silt loam, 0-5 percent slopes	Rb	Rough broken land
Cb	Cloquallum silt loam, 0-5 percent slopes	Hp	Hoquiam silt loam, 5-15 percent slopes	Rc	Rough mountainous land, Hoodsport soil material
Cc	Cloquallum silt loam, 5-15 percent slopes	Hp	Hoquiam silt loam, 15-30 percent slopes	Rd	Rough mountainous land, Tebo soil material
Cd	Cloquallum silt loam, 15-30 percent slopes	Hs	Hoquiam and Astoria silt loams, 5-15 percent slopes	Re	Rough mountainous land, Tebo-Shelton complex
Ce	Cloquallum silt loam, moderately shallow over cemented till, 5-15 percent slopes	Ht	Hoquiam and Astoria silt loams, 15-30 percent slopes	Sa	Saxon silt loam, 5-15 percent slopes
Cf	Cloquallum silty clay loam, 5-15 percent slopes	Ia	Indianola loamy sand, 0-5 percent slopes	Sb	Semiahmoo muck, 0-2 percent slopes
Cg	Coastal beach, 0-2 percent slopes	Ib	Indianola loamy sand, 5-15 percent slopes	Sc	Semiahmoo muck, shallow, 2-10 percent slopes
Da	Deckerville gravelly loam, 0-2 percent slopes	Ic	Indianola loamy sand, 15-30 percent slopes	Sd	Shelton gravelly loam, 5-15 percent slopes
Db	Deckerville gravelly silty clay loam, 0-2 percent slopes	Id	Indianola sandy loam, 0-5 percent slopes	Se	Shelton gravelly sandy loam, 0-5 percent slopes
Dc	Deckerville silt loam, 0-2 percent slopes	Ie	Indianola sandy loam, 5-15 percent slopes	Sf	Shelton gravelly sandy loam, 5-15 percent slopes
Dd	Deckerville silty clay loam, 0-2 percent slopes	Ja	Juno gravelly sandy loam, 0-3 percent slopes	Sg	Shelton gravelly sandy loam, 15-30 percent slopes
De	Delphi gravelly loam, 5-15 percent slopes	Jb	Juno loam, 0-3 percent slopes	Sh	Shelton gravelly sandy loam, 30-45 percent slopes
Df	Delphi gravelly loam, 15-30 percent slopes	Jc	Juno loamy sand, 0-3 percent slopes	Sk	Shelton-Astoria complex, 5-15 percent slopes
Dg	Dungeness fine sandy loam, 0-2 percent slopes	Jd	Juno sandy loam, 0-3 percent slopes	Sm	Shelton-Astoria complex, 15-30 percent slopes
Dh	Dungeness fine sandy loam, shallow, 0-2 percent slopes	Ka	Kitsap silt loam, 0-5 percent slopes	Sn	Sinclair shotty clay loam, 0-5 percent slopes
Dk	Dungeness silt loam, 0-2 percent slopes	Kb	Kitsap silt loam, 5-15 percent slopes	So	Sinclair shotty loam, 5-15 percent slopes
Ea	Edmonds fine sandy loam, 0-2 percent slopes	Kc	Kitsap silt loam, 15-30 percent slopes	Sp	Sinclair shotty loam, 15-30 percent slopes
Eb	Edmonds silt loam, 0-2 percent slopes	Kd	Kitsap silty clay loam, 0-5 percent slopes	Sr	Skokomish silt loam, 0-3 percent slopes
Ec	Eld silt loam, 0-3 percent slopes	Ke	Kitsap silty clay loam, 5-15 percent slopes	Ss	Sol Duc gravelly loam, 0-5 percent slopes
Ed	Everett gravelly loamy sand, 0-5 percent slopes	Kf	Koch gravelly loam, 0-3 percent slopes	St	Sol Duc gravelly loam, 5-15 percent slopes
Ee	Everett gravelly loamy sand, 5-15 percent slopes	Kg	Koch gravelly sandy loam, 0-3 percent slopes	Su	Sol Duc gravelly sandy loam, 0-5 percent slopes
Ef	Everett gravelly loamy sand, 15-30 percent slopes	Kh	Koch silt loam, 0-3 percent slopes	Sv	Stimson silt loam, 0-2 percent slopes
Eg	Everett gravelly sandy loam, 0-5 percent slopes	La	Le Bar silt loam, 0-5 percent slopes	Ta	Tacoma peat, 0-2 percent slopes
Eh	Everett gravelly sandy loam, 5-15 percent slopes	Lb	Lystair loamy sand, 0-5 percent slopes	Tb	Tanwax peat, 0-2 percent slopes
Ek	Everett gravelly sandy loam, 15-30 percent slopes	Lc	Lystair loamy sand, 5-15 percent slopes	Tc	Tanwax peat, shallow over gravel, 0-2 percent slopes
Ga	Gravel pit	Ld	Lystair sandy loam, 0-5 percent slopes	Td	Tebo gravelly loam, 5-15 percent slopes
Gb	Grove cobbley sandy loam, 0-5 percent slopes	Le	Lystair sandy loam, 5-15 percent slopes	Te	Tebo gravelly loam, 15-30 percent slopes
Gc	Grove cobbley sandy loam, 5-15 percent slopes	Lf	Lystair sandy loam, 15-30 percent slopes	Tf	Tebo gravelly loam, 30-45 percent slopes
Gd	Grove cobbley sandy loam, 15-30 percent slopes	Ma	Made land	Tg	Tebo loam, 5-15 percent slopes
Ge	Grove gravelly loam, 0-5 percent slopes	Mb	Maytown silt loam, 0-3 percent slopes	Th	Tebo loam, 15-30 percent slopes
Gf	Grove gravelly loam, 5-15 percent slopes	Mc	McKenna gravelly loam, 0-3 percent slopes	Tk	Tebo-Astoria complex, 5-15 percent slopes
Gg	Grove gravelly loam, basin phase, 0-5 percent slopes	Md	McKenna loam, 0-3 percent slopes	Tm	Tebo-Astoria complex, 15-30 percent slopes
Gh	Grove gravelly sandy loam, 0-5 percent slopes	Me	McMurray peat, 0-2 percent slopes	Tn	Tidal marsh, 0-2 percent slopes
Gk	Grove gravelly sandy loam, 5-15 percent slopes	Mf	McMurray peat, shallow over gravel, 0-2 percent slopes	Wa	Wadell gravelly loam, 0-5 percent slopes
Gm	Grove gravelly sandy loam, 15-30 percent slopes	Mg	Mukilteo peat, 0-2 percent slopes	Wb	Wadell gravelly loam, 5-10 percent slopes
Gn	Grove gravelly sandy loam, 30-45 percent slopes	Mh	Mukilteo peat, shallow over gravel, 0-2 percent slopes	Wc	Wadell loam, 0-5 percent slopes
Go	Grove gravelly sandy loam, basin phase, 0-5 percent slopes	Na	Nasel gravelly loam, 0-5 percent slopes	Wd	Wapato silt loam, 0-3 percent slopes
Gp	Grove stony sandy loam, 0-5 percent slopes	Nb	Nordby loam, 0-5 percent slopes	We	Wapato silty clay loam, 0-3 percent slopes